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Projection of Milk Supply, Demand and Price in the Northeast: An Application of a Multistage Model

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PROJECTION OF MILK SUPPLY, DEMAND AND PRICE IN THE NORTHEAST—AN APPLICATION OF A MULTISTAGE ALLOCATION MODEL

Marvin Kottke [1/]

I. INTRODUCTION

A. The Problem

Changes in sources of milk supply and demand have accelerated recently and are causing concern over the dairy industry's future position in the Northeast economy. Shifting patterns of milk producing areas and urban population centers could seriously disrupt the dairy industry if agricultural areas become widely dispersed. It appears that the thrust of urban-industrial expansion has caused some disagglomeration of farming areas in the Northeast [8,9]. However, it is also conceivable that farming areas beyond the reach of urban-industrial expansion could intensify in dairy production. On the one hand, therefore, the shifting patterns could merely reduce the intensity of dairy farms and leave some farms interspersed among urban-industrial complexes. On the other hand, the shifting patterns might mean that the periphery of concentrated farming is moving farther away from heavily populated centers but that the intensity of farming is remaining high within the concentrated areas. Reduced intensity could have two conflicting effects: (1) It could enhance environmental quality through the retention of open space but, (2) it could also decrease economic efficiency and raise costs because of a wide dispersion of dairy farms and milk assembly plants. An outward movement of the periphery could have just the opposite

1/ Professor of Agricultural Economics.

conflicting effects. Environmental quality might suffer but the concentration of dairy farms and milk assembly plants could increase economic efficiency and reduce marketing costs.

B. Objectives

The purpose of this study is to examine the on-going inter-area shifting patterns and to estimate the potential near-future outcome of these changes. While the study does not deal directly with spatial density, it is concerned with the broader area-wide dispersions of milk supplies. The analysis is aimed at answering the following questions relative to the potential change in status of Northeastern dairy production by 1972: Will the excess-fluid milk producing areas continue to meet the deficit areas' demand for milk? Will the producing areas relocate in the face of urban-industrial expansion and concentrate in predominantly agricultural areas? Will the price of milk increase substantially as the supply expansion potential decreases?

The specific objectives of this study are:

1. To estimate milk demand and supply functions for each state in the Northeast.
2. To estimate the shifters of milk demand and supply over the period 1968-72 and to adjust the demand and supply parameters according to the changing conditions.
3. To solve the spatial and product-use allocation pattern of milk for each year of the period 1968-72.

C. Previous Work

This study reports the results of one of several contributions to the regional "demand-supply equilibrium" phase of the Northeast Dairy Adjustment (hereinafter called NEDA) project.[1/] The NEDA project, which began in 1960 and which was structured somewhat along the same lines as the pioneering Lake States Dairy Adjustment project [15], has gone through two phases. The initial phase dealt with the estimation of area supply functions using the micro-to-macro or representative farm approach. The results of the initial phase are reported in Dairy Adjustments in the Northeast [13].[2/] Starting about 1967 the committee's attention turned to the "demand-supply equilibrium" phase. A few years prior to this time, Takayama and Judge [16] developed an operational quadratic programming formulation for solving spatial equilibrium problems. Naturally the NEDA committee became interested in the prospects of using quadratic programming in its "demand-supply equilibrium" phase. Maruyama and Fuller [11] made a pilot study for NEDA and developed an interregional quadratic programming model for various competitive conditions. Hsiao and Kottke [7] used the Takayama-Judge formulation and a comparative statics framework in a spatial equilibrium analysis of the Northeast dairy industry. Dhillon [5] also did a spatial equilibrium analysis using a comparative statics framework. The major difference between the Dhillon and the Hsiao-Kottke studies was that the former used NEDA supply functions which

1/ The NEDA regional project is cooperatively conducted by the Agricultural Experiment Stations of the Northeastern states and the Economic Research Service, U.S.D.A.

2/ A list of 25 contributing publications by individual members of the NEDA committee is included in the bulletin [13, p. 45].

were held constant for two static time points while the latter used adjusted NEDA supply functions with shifts in supply between two static time points.

While this present study was underway Ching and Frick [2] began developing a regional simulation model to measure the impact of the dairy sub-sector on resource-use and income of a regional economy. Their approach emphasizes the use of measures of spatial densities of farms and related service firms as a major variable. The Ching-Frick model appears to be aimed directly at answering questions on spatial dispersion.

A great deal of previous work serves as background for this present study. Much of the work involved experimentation with new methods. Quite often the new methods were mainly applicable to only one dimension of the problem. However, the milk allocation problem, as is true for many other problems, is multidimensional in nature. Therefore, in 1968 the NEDA committee encouraged the development of a multidimensional regional model for use in the second phase of the project and the results of that development are presented in this report.

II. THE MULTISTAGE ALLOCATION MODEL

A. Rationale for the Model

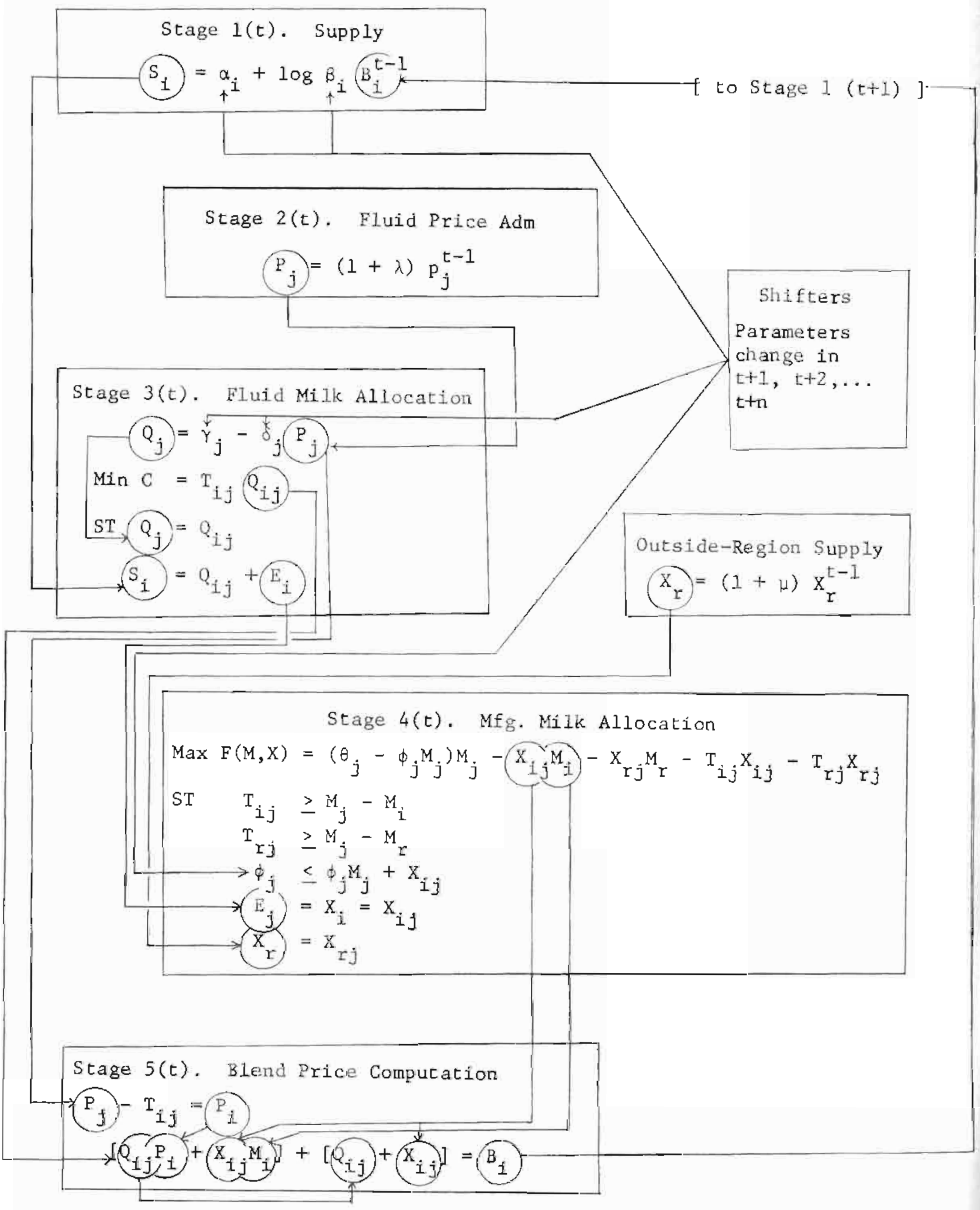
This model is constructed to deal with two real-world conditions in the dairy industry, namely, (1) the multidimensional nature of the milk allocation problem, and (2) the diversity of the competitive structure within the dairy industry. We retain the use of quadratic programming to deal with the spatial dimension, but, clearly, other formulations have to be added to deal with other dimensions and the diversity of competitive conditions.

With regard to the time dimension we use a set of recursive relations to separate the pricing and allocation process into a sequence of decision points rather than assume that the whole production process occurs simultaneously at a single point in time. For "diversity of competitive conditions" we separate the demand and supply functions appropriately for each of the decision points in the timing sequence and then attach relevant competitive conditions to each of the sets of demand and supply functions.

B. Explanation of the Model

The mathematical formulation of the multistage allocation model is published in the American Journal of Agricultural Economics [10] and readers are referred to the article for a more complete explanation. In this report the basic workings of the model are illustrated with the aid of Figure 1. Starting at the farm level, we can trace in year t a supply of milk for each area (S_i) as it passes through the five stages in the process of being allocated between fluid and manufacturing uses.

Figure 1. Schematic Outline of the Multistage Spatial Allocation Model



At Stage 1, the supply of milk in year t is determined. The quantity forthcoming is dependent on producers' response to last year's blend price. At this point, variations in response are limited to the range prescribed by the marginal cost of feeding cows.1/ Perfectly competitive conditions are assumed to prevail at this point.

At Stage 2, the price of fluid milk (P_j) in year t is determined. We assume that a milk market administration sets the price by applying a pricing formula.2/ The introduction of the formula reflects the institutional element of market behavior in the dairy industry.

At Stage 3, the quantity of milk needed for fluid uses (Q_j) is determined for each area j . Given the price set by the administrator, processors plan on allocating Q_j to fluid uses based on their demand functions which are derived from consumer demand. Once processors have determined their fluid demand, they then decide on sources of supply. A "transportation cost-minimizing" linear programming formulation is used to determine sources and quantities of milk shipments. Tracing the supply (S_i) of milk from Stage 1 to Stage 3, we can see that is is allocated to either fluid milk (Q_{ij}) or excess milk (E_i). The latter is diverted to manufacturing milk in the next stage. In Stage 3, imperfect competition is incorporated in the form of control of supply sources. The number of inter-area shipping activities are largely confined to those prevailing under existing Federal Milk Orders.

1/ Variations in response due to technological change, economies of size, growth of firms, and exit and entry of firms enter later as inter-year shifters of supply.

2/ The formula used in the model is generally representative of the kind used historically. A more specific formula could be used for specific applications of the model. See Appendix A for a more detailed explanation of the pricing formula.

At Stage 4, the quantity (X_{ij}) and price (M_i) of manufacturing milk is determined for each area i and j. Here we assume that perfectly competitive conditions prevail; that the supply is a combination of the predetermined excess fluid milk (E_i) and a given supply (X_r) being imported from outside the region, and that the derived demand (X_{ij}) is a continuous linear function of price. Accordingly, this stage can be formulated and solved as a quadratic programming problem.

At Stage 5, the blend price to be paid to producers is computed as a weighted average of the fluid and manufacturing milk prices in each area.

Finally, the sequence is repeated for successive years by applying the blend price of year t to Stage 1 for year $t + 1$ and by adjusting the parameters of the supply and demand functions according to projections of the demand and supply shifters. The demand shifters are changes in population, income, tastes and preferences. The supply shifters are changes in technology and number of cows. The latter is a proxy measure of an aggregate of major adjustments involving capital investment and disinvestment, economies of size, and exit and entry of firms.

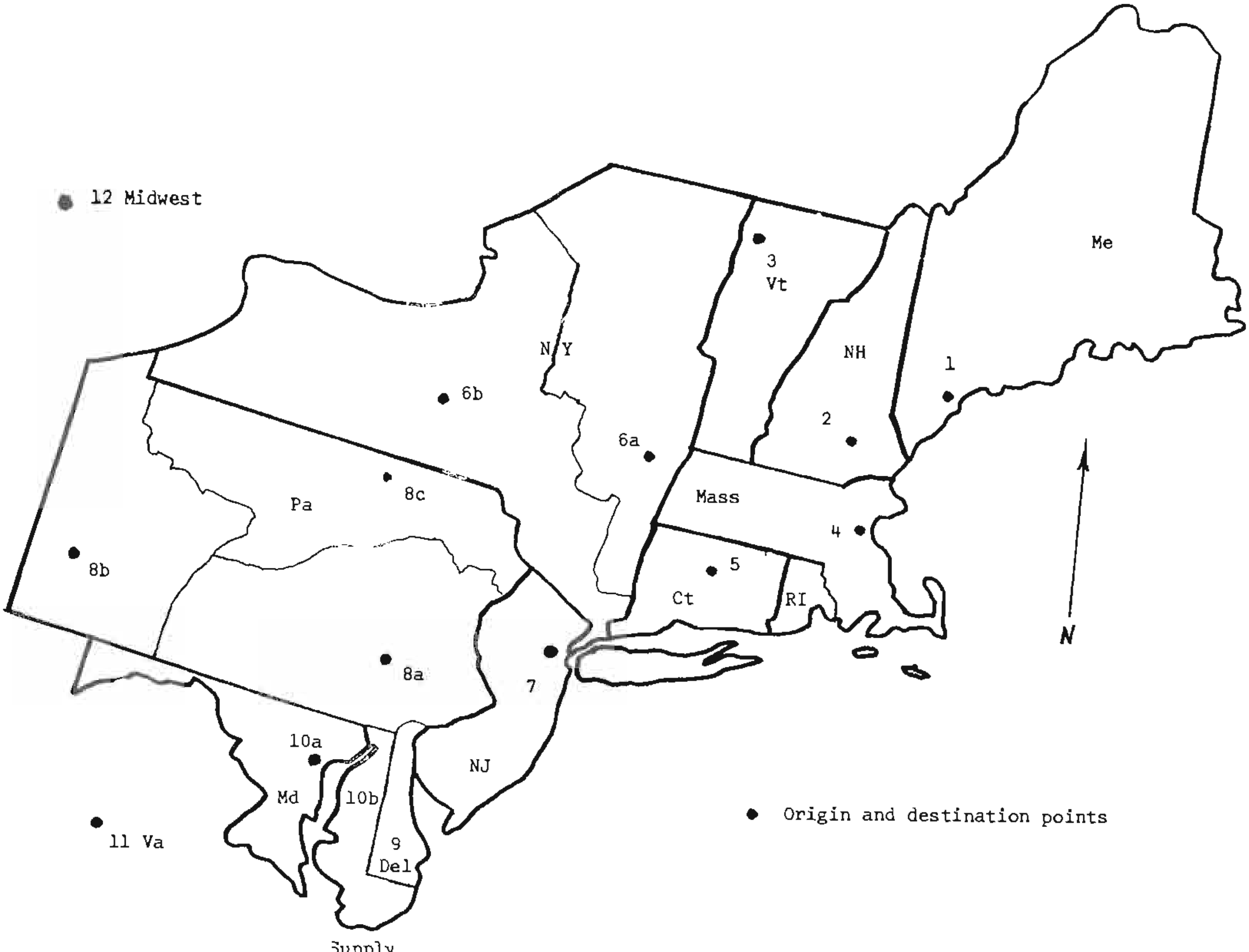
III. PROCEDURE

A. Area Demarcation

The concepts underlying a spatial equilibrium analysis are based on the existence of spatially separated areas. The separation is supposed to be sufficiently clear-cut so that inter-area trade can be easily distinguished from intra-area trade. For example, physical separations, such as mountains, rivers, lakes or oceans, are usually thought of as boundaries for spatially separated areas. However, in economic analysis it is usually more convenient, from the availability of data standpoint, to demarcate areas on the basis of state, regional and other governmental area boundaries.

Two sets of area demarcations are used. The first set consists of ten areas based exclusively on state boundaries (Figure 2). Eleven Northeastern states are represented--nine separately and Rhode Island-Massachusetts combined. (West Virginia is not included.) The major reason for using state designations is that many secondary sources report data on a state basis, and secondary sources ease the task of collecting, preparing and comparing data. Therefore, the ten state-designated areas are used in the first part (the data preparation) and the last part (the comparison of estimated with reported data) of the study.

The second set consists of twelve Northeastern areas which result from subdividing and recombining the ten state-designated areas. New York is divided into two subareas; Pennsylvania is divided into three subareas, and Maryland is divided into two subareas. Then Area 8a (southeastern Pennsylvania) is recombined with Area 9 (Delaware) and



12 Midwest
Me
3
Vt
N Y
NH
1
6b
2
6a
Mass
8c
Pa
4
5
8b
Ct
RI
N
7
8a
10a
NJ
Md
10b
11 Va
9
Del
Supply
Origin and destination points

Area 10b (eastern Maryland). This second set of areas corresponds more closely to the geographical areas covered by the existing Federal Milk Order markets. The result is, admittedly, a compromise between state and market designations; however, the second set of areas serves a useful purpose and is used for a major part of the analysis.

Two outside-supply areas are added as sources of manufacturing milk products. These latter two do not have geographical boundaries but are located in the general vicinities of Virginia and the Lake States Dairy Region.

A listing and description of the areas with their representative shipping points are presented in Table 1. The possible or allowable inter-area shipping designations and distances between shipping points are shown in Table 2.

B. Demand and Supply Estimates

Operation of the model calls for data prepared on a state basis and for specific dates in time. It was decided to set 1967 as the base year and project the data for five years, 1968 to 1972. Committee members of the NEDA project provided basic data from their respective states for the construction of supply functions.

The procedure used for constructing supply functions was to estimate "marginal cost per cow" functions from the feed-milk production function used in an earlier phase of the project. Next a projection of cow numbers was made and then the "marginal cost per cow" function for each state was multiplied by the number of cows to obtain the aggregate supply function for each state and each year [17].

Table 1. Origin and Destination Shipping Points, Northeastern Areas

Supply Areas	Origin Point	Destination Areas
1	Portland, Me.	1, 2, and 4
2	Concord, N. H.	2, 4, and 5
3	St. Albans, Vt.	1, 2, 3, 4, and 5
4	Boston, Mass.	4, 5, and 6a
5	Hartford, Ct.	4, 5, and 6a
6a	Albany, N. Y.	4, 5, 6a, and 7
6b	Cortland, N. Y.	6a, 6b, and 8c
7	Newark, N. J.	6a, 7, and 8a
8a+	Reading, Pa. 1/	7, 8a+, 8b, and 10
8b	Pittsburg, Pa.	8a+, 8b, and 10
8c	Towanda, Pa.	6a, 6b, 7, and 8c
10a	Baltimore, Md.	8a+, and 10
11	Petersburg, Va.	10
12	Chicago, Ill. (Midwest)	4, 5, 6a, 6b, 7, 8a+, 8b, 8c, and 10

1/ Area 8a+ includes Area 8a, Area 9 (Delaware) and Area 10b (Eastern Maryland).

Table 2. Inter-Area Transportation Distances, Northeastern Areas

Supply Areas	Demand Areas Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa[1/] 8a+	Pa 8b	Pa 8c	Md 10a
	(miles)											
1 Me	0	90		105								
2 NH		0		75	140							
3 Vt	210	180	0	245	255							
4 M-RI				0	90	170						
5 Ct				90	0	110						
6a NY				170	110	0		145				
6b NY						135	0				90	
7 NJ						145		0	115			
8a+ Pa [1/]								115	0	260		90
8b Pa									260	0		235
8c Pa						220	90	190			0	
10a Md									90			0
11 Va												150
12 MW				990	920	820	700	800	725	470	635	690

1/ Includes Areas 8a (Pa), 9 (Del) and 10b (Md).

Prior to 1968, Dhillon [4] had worked out a procedure for estimating milk demand functions using Brandow's [1] demand elasticity coefficients. Essentially the same procedure was used by the NEDA committee. The procedure involved three steps. First, an estimation of a "per capita" demand function for each state was made. Second, this was multiplied by population to obtain the aggregate for each state. Third, projections of population, income and tastes and preferences were made. The latter were used to adjust the parameters of each state's demand function for the years 1968-72 [18].

C. The Linear and Quadratic Programming Matrices

In the linear programming matrix for Stage 3, allowance is made for 12 areas. Table 3 illustrates the general layout of the shipping activities for fluid milk. Each area is allowed five shipping activities making a possible total of 60. For the application reported herein, fewer than the 60 possible activities are used because some areas are assigned less than five shipping opportunities. The assigned activities correspond to the inter-area transportation data in Table 2.

The layout of the shipping activities for manufacturing milk is illustrated in the quadratic programming matrix shown in Table 4. For this stage, two outside areas are added to the 12 areas allowed for in the previous stage. These two outside areas are allowed a total of ten shipping activities. Consequently, the model is set up for 60 intraregional (Activities 27-86) and ten interregional shipping activities (87-96). As in the previous stage, not all of the possible activities are utilized for the application reported herein. We mention this point to indicate that some flexibility of shipping opportunities is built into the model for applications requiring a different pattern of shipping activities.

Table 3. Linear Programming Simplex Tableau for Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model *

Act. I.D. →			1-60	61-72	73-84
↓	C_j →		T	-M	-M
	C_i ↓	P_o	$Q_{ij} \geq 0$	$E_{ij} \geq 0$	$D_{ij} \geq 0$
61-72	-M	S	G	I_e	
73-84	-M	Q			I_j

* T is a vector of inter-area and intra-area transportation costs.

S " " " " milk supply quantities.

Q " " " " milk demand quantities.

Q_{ij} " " " " the inter-area and intra-area transportation activities.

E_{ij} " " " " " slack activities representing excess supply.

D_{ij} " " " " " slack activities for demand.

G " " matrix of demand and supply coefficients.

I_e " an identity matrix for the supply slack activities (excess supply).

I_j " " " " " " demand slack activities.

Table 4. Quadratic Programming Simplex Tableau for Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model *

Act. I. D. →			1-24	25-26	27-86	87-96	97-108	109-120	121-122	123-192
↓	C_j →		0	0	0	0	0	0	0	0
	C_i ↓	P_o	$M_i, M_j \geq 0$	$M_r \geq 0$	$X_{ij} \geq 0$	$X_{rj} \geq 0$	$D_{ij} \geq 0$	$D_{ij} \geq 0$	$D_{ij} \geq 0$	$D_{ij} \geq 0$
123-192	-M	T	G'	R'						I
97-108	-M	θ	ϕ				$-I_j$			
109-120	-M	X_i			G			I_i		
121-122	-M	X_r				R			I_r	

* T is a vector of inter-area transportation costs.

θ " " " " intercept quantities of the demand functions.

X_i " " " " supply quantities originating in the region.

X_r " " " " " " " outside of the region.

M_i, M_j and M_r are vectors of the manufacturing milk prices for i, j and r areas, respectively.

X_{ij} is a vector of the inter-area and intra-area transportation activities within the region.

X_{rj} " " " " " " " transportation activities with supply originating outside the region.

D_{ij} " " " " the slack activities.

G' " " matrix of demand and supply coefficients for shipments within the region.

R' " " " " demand and supply coefficients for shipments from outside of the region.

ϕ " " " " the slope parameters of the demand functions.

I, I_i, I_j and I_r are identity matrices for the respective price, demand, and supply, and outside supply slack activities.

IV. INPUT DATA FOR THE MODEL

A. Demand and Supply Function Estimates

The NEDA committee's estimates of marginal cost functions are shown in Table 5. These are the "per cow" supply functions. Variation by states reflects the differences in average productivity per cow. The aggregate supply functions obtained by multiplying by number of cows in each area are shown in Table 6.

The "per capita" demand data used for estimating demand functions are shown in Table 7. As in the case of supply, variations occur by states. Variations in per capita demand largely reflect differences in consumer income. Aggregate demand functions are shown in Table 8 and variations, in this case, reflect differences in population.

B. Parameter Shifters and Five-year Sets of Demand and Supply Functions

The five-year sets of supply functions resulting from the shifts in supply are shown in Table 9. (Supply functions for the subdivided areas are presented in Appendix Table 5.) Notice that all areas exhibit backward or negative shifts in supply. This is a consequence of the projected declines in "cow numbers" (Table 10) more than offsetting the increases in "production per cow" (the parameter shifter in Table 5).

In the next table, we can examine the shifting pattern of demand over time (Table 11; also see Appendix Table 6 for the subdivided areas' demand functions). Of interest here is the diversity among areas regarding the direction of projected shifts. In the case of fluid milk, Maine, Massachusetts, Rhode Island, and Pennsylvania are expected to experience

Table 5. Marginal Cost Functions of Milk Production, Per Cow, Northeastern States, 1968 *

Area	Quantity intercept (α)	Slope coefficient (β)	Parameter shifter a/
	(cwt.)	(cwt.)	(cwt.)
1 Me	84.04	11.58	1.56
2 NH	90.14	9.40	1.81
3 Vt	85.55	10.99	1.66
4 M-RI	96.72	9.56	1.75
5 Ct	98.20	9.46	2.34
6 NY	96.01	11.24	1.61
7 NJ	98.44	11.05	1.32
8 Pa	91.25	9.86	1.71
9 Del	86.88	10.00	1.50
10 Md	86.62	11.24	2.49

* Estimated by members of the NEDA Committee following procedures developed by Zepp [17]. The marginal cost function was derived from a feed-milk production function and the derived data were fitted to an equation of the following form:

$$V = \alpha + \beta \log (MC - k)$$

where

MC = marginal cost of feed per cwt. of milk
V = quantity (cwt.) of milk per cow per year
k = a constant (k = 3.10 for all areas except the following: Area 2, k = 3.20; Area 8, k = 3.30; Area 9, k = 3.30).

a/ This shifter represents the annual change in production per cow due to technological change. The value of the shifter was estimated using 1963-1967 data for the following regression equation:

$$A = f + g L$$

where

A = production per cow per year adjusted for milk prices
f = constant term
g = regression on time (the value of the shifter)
= time (1963 = 1).

Table 6. Milk Supply Functions, Northeastern States, 1968 *

Area	Quantity intercept (α)	Slope coefficient (β)
	(mil. cwt.)	
1 Me	5.7840	.7970
2 NH	3.5828	.3736
3 Vt	18.0233	2.3153
4 M-RI	7.6017	.7522
5 Ct	6.3587	.6126
6 NY	101.6131	11.6998
7 NJ	7.9945	.8974
8 Pa	67.0343	7.2434
9 Del	1.2225	.1407
10 Md	14.5769	1.8915

* Estimated by members of the NEDA Committee following procedures developed by Zepp [17]. The form of the function is:

$$S = \alpha + \beta \log (B^{t-1} - k)$$

where

S = quantity of milk

B^{t-1} = the blend price of milk in the previous year

k = a constant as defined in Table 6.

The above supply functions were obtained by multiplying the parameters of the "per cow" marginal cost functions for 1968 (Table 5) by the number of cows in 1968 (Table 10) for each state.

Table 7. Milk Prices, and Per Capita Demand Function Intercepts, Northeastern States, 1967

Area	Fluid Milk		Manufacturing Milk	
	Price a/	Intercept b/	Price a/	Intercept c/
	(dollars)	(pounds)	(dollars)	(pounds)
1 Me	6.81	367	3.80	482
2 NH	6.38	368	3.97	497
3 Vt	6.32	365	3.91	491
4 M-RI	6.53	376	4.12	513
5 Ct	6.95	386	4.13	521
6 NY	6.06	375	4.07	513
7 NJ	6.06	374	4.07	513
8 Pa	6.50	371	3.95	498
9 Del	6.64	378	4.30	525
10 Md	6.61	376	4.09	510

a/ See Appendix Table 4 for Federal Milk Order prices. Prices for Me., N.H., Vt., Penn. and Del. were estimated by the members of the NEDA Committee.

b/ Obtained by using the following equation:

$$Y - P\,(-\ 9.56) = u$$

where

Y = per capita fluid milk

P = fluid milk price

u = quantity axis intercept

The per capita slope coefficient (- 9.56) was obtained from Brandow [1].

c/ Obtained by using the following equation:

$$K - M\,(-\ 52.94) = v$$

where

K = per capita manufacturing milk consumption

M = manufacturing milk price

v = quantity axis intercept

The per capita slope coefficient (- 52.94) was obtained from Brandow [1].

Table 8. Aggregate Demand Functions, Northeastern States, 1967 *

Area	Fluid Milk a/		Manufacturing Milk b/	
	Quantity intercept (γ)	Slope coefficient (δ)	Quantity intercept (θ)	Slope coefficient (ϕ)
	(mil. cwt.)			
1 Me	3.6186	- .0943	4.7525	.5219
2 NH	2.5392	- .0660	3.4293	.3652
3 Vt	1.5221	- .0399	2.0875	.2207
4 M-RI	23.7444	- .6037	32.3960	3.3425
5 Ct	11.2558	- .2788	15.1924	1.5434
6 NY	67.5263	-1.7215	92.3759	9.5311
7 NJ	26.0715	- .6664	35.7612	3.6898
8 Pa	43.2957	-1.1157	58.1166	6.1769
9 Del	1.9807	- .0501	2.7510	.2774
10 Md	13.8406	- .3519	18.7731	1.9484

* Obtained by multiplying the per capita demand parameters in Table 7 by the population for each state.

a/ The form of the fluid milk demand equation is

$$Q = \gamma - \delta P$$

where

Q = quantity of fluid milk

P = price of fluid milk.

b/ The form of the manufacturing milk demand is

$$X = \theta - \phi M$$

where

X = quantity of manufacturing milk

M = price of manufacturing milk.

Table 9. Milk Supply Functions, Northeastern States, 1968-1972 *

Area and Year	Quantity intercept (α)	Slope coefficient (β)
	(mil. cwt.)	
1 Me		
1968	5.7840	.7970
1969	5.6050	.7583
1970	5.4156	.7195
1971	5.2158	.6808
1972	5.0055	.6420
2 NH		
1968	3.5828	.3736
1969	3.5015	.3580
1970	3.4141	.3423
1971	3.3207	.3266
1972	3.2212	.3109
3 Vt		
1968	18.0233	2.3153
1969	17.7709	2.2394
1970	17.4955	2.1636
1971	17.1972	2.0877
1972	16.8759	2.0118
4 M-RI		
1968	7.6017	.7522
1969	7.3465	.7142
1970	7.0778	.6761
1971	6.7954	.6381
1972	6.4994	.6000
5 Ct		
1968	6.3587	.6126
1969	6.2254	.5858
1970	6.0789	.5590
1971	5.9191	.5322
1972	5.7460	.5054
6 NY		
1968	101.6131	11.6998
1969	100.6215	11.3976
1970	99.5434	11.0955
1971	98.3787	10.7933
1972	97.1275	10.4912

Table 9. (Continued)

Area and Year	Quantity intercept (α)	Slope coefficient (β)
	(mil. cwt.)	
7 NJ		
1968	7.9945	.8974
1969	7.4247	.8224
1970	6.8371	.7474
1971	6.2315	.6724
1972	5.6079	.5975
8 Pa		
1968	67.0343	7.2434
1969	66.2763	7.0297
1970	65.4442	6.8161
1971	64.5381	6.6025
1972	63.5578	6.3888
9 Del		
1968	1.2225	.1407
1969	1.1101	.1256
1970	.9931	.1105
1971	.8714	.0954
1972	.7453	.0802
10 Md		
1968	14.5769	1.8915
1969	14.4273	1.8198
1970	14.2459	1.7481
1971	14.0328	1.6764
1972	13.7879	1.6046

* The form of the supply function is

$$S = \alpha + \beta \log (B^{t-1} - k)$$

where

S = quantity of milk in mil. cwt.

B^{t-1} = the blend price of milk in the previous year

k = a constant as defined in Table 5.

Table 10. Estimated Number of Cows, Northeastern States, 1968-72 *

Area	Number of Cows					Percent Change
	Year					
	1968	1969	1970	1971	1972	1968-69
1 Me	68,824	65,479	62,134	58,789	55,444	- 4.9
2 NH	39,747	38,080	36,413	34,746	33,079	- 4.2
3 Vt	210,676	203,771	196,866	189,961	183,056	- 3.3
4 M-RI	78,667	74,688	70,709	66,730	62,751	- 5.1
5 Ct	64,753	61,920	59,087	56,254	53,421	- 4.4
6 NY	1,040,904	1,014,023	987,142	960,261	933,380	- 2.6
7 NJ	81,212	74,426	67,640	60,854	54,068	- 8.4
8 Pa	734,622	712,955	691,288	669,621	647,954	- 3.0
9 Del	14,071	12,560	11,049	9,536	8,024	-10.8
10 Md	168,285	161,904	155,523	149,142	142,761	- 3.8

* Estimated by members of the NEDA Committee following procedures developed by Zepp [17]. Projection of data based on 1960-67 data and the following estimation equation:

$$H = a + b L$$

where

H = number of cows

a = constant term

b = slope coefficient

L = time in years (L = 9 for 1968).

Table 11. Milk Demand Functions, Northeastern States, 1968-72 *

Area and Year	Fluid Milk Quantity intercept (γ)	Fluid Milk Slope coefficient (δ)	Manufacturing Milk Quantity intercept (θ)	Manufacturing Milk Slope coefficient (ϕ)
	(mil. cwt.)			
1 Me				
1968	3.5996	.0945	4.8333	.5231
1969	3.5807	.0947	4.9155	.5244
1970	3.5619	.0949	4.9990	.5256
1971	3.5432	.0952	5.0840	.5269
1972	3.5246	.0954	5.1704	.5282
2 NH				
1968	2.5577	.0671	3.5291	.3713
1969	2.5764	.0687	3.6318	.3774
1970	2.5952	.0698	3.7375	.3837
1971	2.6142	.0710	3.8462	.3901
1972	2.6333	.0721	3.9582	.3965
3 Vt				
1968	1.5219	.0401	2.1342	.2222
1969	1.5217	.0404	2.1820	.2237
1970	1.5216	.0407	2.2309	.2253
1971	1.5215	.0410	2.2809	.2268
1972	1.5214	.0412	2.3320	.2283
4 M-RI				
1968	23.6827	.6078	33.0180	3.3649
1969	23.6211	.6118	33.6519	3.3875
1970	23.5597	.6159	34.2980	3.4102
1971	23.4984	.6200	34.9565	3.4330
1972	23.4373	.6242	35.6277	3.4560
5 Ct				
1968	11.3469	.2835	15.6481	1.5698
1969	11.4388	.2884	16.1175	1.5967
1970	11.5315	.2933	16.6010	1.6240
1971	11.6249	.2983	17.0990	1.6517
1972	11.7191	.3034	17.6120	1.6800
6 NY				
1968	67.6174	1.7411	94.5006	9.6398
1969	67.7087	1.7609	96.6741	9.7497
1970	67.8001	1.7810	98.8976	9.8608
1971	67.8916	1.8013	101.1722	9.9732
1972	67.9833	1.8218	103.4992	10.0869

Table 11. (Continued)

Area and Year	Fluid Milk		Manufacturing Milk	
	Quantity intercept (γ)	Slope coefficient (δ)	Quantity intercept (θ)	Slope coefficient (ϕ)
		(mil. cwt.)		
7 NJ				
1968	26.2606	.6784	36.7876	3.7558
1969	26.4509	.6905	37.8434	3.8230
1970	26.6427	.7029	38.9295	3.8915
1971	26.8359	.7154	40.0468	3.9611
1972	27.0304	.7282	41.1961	4.0320
8 Pa				
1968	43.0424	1.1190	59.0523	6.1955
1969	42.7911	1.1223	60.0030	6.2140
1970	42.5407	1.1257	60.9691	6.2327
1971	42.2918	1.1290	61.9507	6.2514
1972	42.0444	1.1325	62.9481	6.2701
9 Del				
1968	1.9984	.0511	2.8344	.2829
1969	2.0163	.0521	2.9202	.2885
1970	2.0344	.0531	3.0087	.2942
1971	2.0526	.0542	3.0999	.3001
1972	2.0710	.0553	3.1938	.3060
10 Md				
1968	14.0004	.3592	19.4001	1.9887
1969	14.1621	.3666	20.0481	2.0298
1970	14.3257	.3742	20.7177	2.0719
1971	14.4912	.3820	21.4097	2.1148
1972	14.6585	.3899	22.1247	2.1585

* The demand functions are linear in form as defined in Table 8.

negative shifts in demand. All of the other states, except Vermont which essentially stays constant, are expected to experience positive shifts. In contrast, the demand for manufacturing milk exhibits a positive shift for all areas.

The extent of influence by the three shifters of demand is shown in Tables 12 and 13. As may be expected, population growth is the dominant, positive influence, while changes in tastes and preferences have a negative effect.

C. Supply from Outside of the Northeast Region

Estimates of total regional milk production (237.69 million hundredweight) and consumption (317.84 million hundredweight) were made for the base year, 1967, by Zepp [18]. The difference (80.15), obviously was shipped in from outside of the region. Dhillon's [5] study indicated that 4.29 million hundredweight were shipped from the "Virginia" area to the Northeast in 1965. It was assumed, therefore, that an outside supply of 75.65 million hundredweight from Area 12 (Midwest) and 4.5 million hundredweight from Area 11 (Virginia) would be a reasonable approximation for 1968. An examination of 1967-68 changes in milk marketed for United States, Northcentral region and Virginia revealed that the percentage changes were -.009, -.013, and +.002, respectively. On the basis of these data and general knowledge of the dairy industry, it is further assumed that the supply from outside sources would remain constant over the 1968-72 period.

Table 12. Parameter Shifters of Fluid Milk Demand Functions, Northeastern States *

Area	Parameter Shifters a/			
	Income b/	Tastes and preferences c/	Population d/	Total
	(percent of quantity)			
1 Me	.01035	-.018	1.0024	.99475
2 NH	.00870	-.018	1.0166	1.00730
3 Vt	.01110	-.018	1.0068	.99990
4 M-RI	.00870	-.018	1.0067	.99740
5 Ct	.00900	-.018	1.0171	1.00810
6 NY	.00795	-.018	1.0114	1.00135
7 NJ	.00735	-.018	1.0179	1.00725
9 Pa	.00915	-.018	1.0030	.99415
9 Del	.00705	-.018	1.0199	1.00895
10 Md	.00885	-.018	1.0270	1.01155

* Estimated by following the procedures developed by Zepp [18].

a/ The total shifter applies to the intercept parameter, whereas the population shifter applies to the slope parameter.

b/ Computed by Zepp [18]. An income elasticity for fluid milk (.15) was multiplied by the income growth rate.

c/ The residual effect obtained after the income and price effects of changes in per capita consumption rates between 1963 and 1969 were removed.

d/ Population growth rate data were obtained from the U. S. Department of Commerce, Population Estimates [14, Table 1, projection series I-B]. The population elasticity for milk (1.0) was multiplied by the population growth rate.

Table 13. Parameter Shifters of Manufacturing Milk Demand Functions, Northeastern States *

Area	Parameter Shifters a/			
	Income b/	Tastes and preferences c/	Population d/	Total
	(percent of quantity)			
1 Me	.01311	.0015	1.0024	1.01701
2 NH	.01102	.0015	1.0166	1.02912
3 Vt	.01406	.0015	1.0068	1.02236
4 M-RI	.01102	.0015	1.0067	1.01922
5 Ct	.01140	.0015	1.0171	1.03000
6 NY	.01007	.0015	1.0114	1.02297
7 NJ	.00931	.0015	1.0179	1.02871
8 Pa	.01159	.0015	1.0030	1.01609
9 Del	.00893	.0015	1.0199	1.03341
10 Md	.01121	.0015	1.0207	1.03341

* Estimated by the procedures referred to in Table 12.

a/ The total shifter applies to the intercept parameter, whereas the population shifter applies to the slope parameter.

b/ Based on an income elasticity for manufacturing milk of .19. See Table 12.

c/ See Table 12.

d/ See Table 12.

D. Transportation Costs

The distances between shipping points were obtained from highway maps. Inter-area transportation costs were estimated by assuming a constant rate of $.20 per hundredweight per 100 miles (Table 14). One representative shipping point was selected for each area. We assume that each shipping point is a major assembly and distribution center for the area and as such represents all other assembly and distribution plants in the area. Because of this assumption, assembly and distribution costs within each area are not included.

E. Base Year Data

Because of the recursive relations in the model it is necessary to provide base year data on milk production, consumption and prices to start the allocation process for the first year. These data are presented in Appendix B.

Table 14. Inter-area Transportation Cost, Northeastern Areas *

Supply Areas	Demand Areas											
	Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 8a+ 1/	Pa 8b	Pa 8c	Md 10
	(dollars)											
1 Me	0	.18		.21								
2 NH		0		.15	.28							
3 Vt	.42	.36	0	.49	.51							
4 M-RI				0	.18	.34						
5 Ct				.18	0	.22						
6a NY				.34	.22	0		.29				
6b NY						.27	0				.18	
7 NJ						.29		0	.23			
8a+ Pa 1/								.23	0	.52		.18
8b Pa									.52	0		.47
8c Pa						.44	.18	.38			0	
10 Md									.18			0
11 Va												.30
12 MW				1.98	1.84	1.64	1.40	1.60	1.45	.94	1.27	1.38

* Based on a rate of $.20 per 100 lbs. per 100 miles.
1/ Includes Area 8a (Pa), 9 (Del) and 10b (Md).

V. SOLUTIONS

Application of the multistage allocation model results in a multisolution. There is a solution for each of the five years in the period 1968-72 and for each year there are five solutions for the five stages. However, the solutions will not be presented in the order and multisolution form obtained in the computer printout. Instead, the solutions were scanned for appropriate information to answer the three questions stated in the introduction and the information thus obtained will be presented in the order that the questions were posed.

A. Prospects for an Adequate Supply of Fluid Milk

The regional supply of fluid milk

This section is addressed to the question: Will the excess-fluid milk producing areas continue to meet the deficit areas' demand for milk in 1972? The Northeastern dairy industry produces principally for the fluid milk market. In the solutions for 1968, fluid uses account for an estimated 67.1 percent of the region's milk production, or stated conversely, total production exceeded fluid demand by 32.9 percent (Table 15). Having an excess supply above fluid demand may or may not be a problem depending upon the industry's facilities for converting the excess into manufactured milk products. In general, milk producers as a group prefer the fluid market because of the price differential for Class I milk. To some extent, therefore, milk producers' organizations attempt to minimize the excess supply or to utilize it as effecively as possible.

Table 15. Estimated Milk Supply, Fluid Demand and Excess-Fluid Supply, Northeastern Region, 1968-72

	Year				
	1968	1969	1970	1971	1972
Supply of milk (mil. cwt.)	243.10	239.62	236.37	232.69	228.69
Fluid demand for milk (mil. cwt.)	163.20	162.64	162.08	161.46	160.81
Excess fluid milk (mil. cwt.)	79.90	76.98	74.29	71.23	67.88
Excess as a percent of supply	32.9	32.1	31.4	30.6	29.7

With dairy farms exiting at a rapid rate in recent years and with a steady increase in population, the excess-fluid supply could be expected to vanish in the near future. However, the solutions of this study do not support that expectation. The solutions indicate that the excess-fluid supply would decline from 79.9 million hundredweight in 1968 to 67.9 million hundredweight in 1972, but the excess would remain at a nearly 30 percent level. The reason that the excess does not diminish more is that the allocation model projects a slight decline in fluid milk consumption even though population increases. Even if milk consumption increases slightly, the regional supply of milk would likely remain adequate for fluid uses beyond 1972.

The individual areas' supplies of fluid milk

While the region's over-all supply of fluid milk is adequate, several areas within the region have deficit supplies and depend upon inter-area shipments to meet their area's demand (Table 16). The deficit-fluid areas include Area 7 (NJ), Area 4 (M-RI) and Area 5 (Ct). Two others, Area 2 (NH) and Area 10a (Md) have essentially "balanced" fluid supplies. The rest of the areas not only produce most of the region's milk supply but also produce substantially more than their area's demand requirements for fluid milk.

The model's projections to 1972 indicate that decreases in production would be widespread but decreases in consumption would be less widespread. Accordingly the impact of the projected changes would vary among the areas. In general, the deficit and "balanced" areas, which incidentally are the most likely to have increases in consumption, would experience the greatest relative impact. For example, the deficits of Areas

Table 16. Estimated Milk Supply, Intra-area Fluid Demand and Excess-Fluid Supply, Northeastern Areas, 1968 and 1972

Area		1968 Supply of milk	1968 Intra-area demand for fluid milk	1968 Excess or deficit	1972 Supply of milk	1972 Intra-area demand for fluid milk	1972 Excess or deficit	Percent change in excess or deficit 1968-72
				(mil. cwt.)				
Excess-fluid supply areas								
6a	NY	30.53	5.00	25.53	29.52	4.87	24.65	- 3
6b	NY	74.64	51.78	22.86	72.21	51.30	20.91	- 9
3	Vt	18.91	1.26	17.65	17.78	1.24	16.54	- 6
8a+	Pa 1/	38.82	23.28	15.54	36.72	22.37	14.35	- 8
8c	Pa	17.22	2.54	14.68	16.18	2.45	13.73	- 6
8b	Pa	18.07	12.62	5.45	17.21	12.05	5.16	- 5
1	Me	6.16	2.98	3.18	5.37	2.86	2.50	-21
2	NH	3.75	2.12	1.63	3.40	2.14	1.26	-23
10a	Md	12.01	10.76	1.25	11.49	10.95	.54	-57
Deficit fluid supply areas								
7	NJ	8.34	21.88	-13.54	5.92	22.17	-16.25	20
4	M-RI	7.98	19.65	-11.67	6.83	19.05	-12.22	5
5	Ct	6.67	9.33	- 2.66	6.06	9.36	- 3.30	24

1/ Includes Areas 9 (Del) and 10b (Md).

5 (Ct) and 7 (NJ) would increase about 20 percent and the excess supplies of Areas 2 (NH) and 10a (Md) would decrease over 20 percent. On the other hand, the excess supplies of Areas 3 (Vt), 6a (NY), 8b (Pa) and 8c (Pa) would decrease only about 3-6 percent according to the solutions. It appears, therefore, that the latter areas would continue to have ample supplies of fluid milk to meet the deficit areas' demands until 1972 and perhaps many more years into the future.

B. Prospects for Concentration of the Dairy Industry in Specific Locations of the Northeast

The solution information presented in this section deals largely with inter-area shipments of milk. Changes in trade patterns are used as evidence of potential concentrations of dairy farming. This section attempts to answer the question: Will the producing areas relocate in the face of urban-industrial expansion and concentrate in predominantly agricultural areas?

Projected changes in spatial allocation of fluid milk between 1968 and 1972

In the previous section it was shown that projected excess-fluid supplies for Areas 3 (Vt), 6a (NY), 8b (Pa) and 8c (Pa) change *relatively little* in the period 1968-72. However, important changes in quantities allocated to fluid uses would occur. In Table 17 it can be seen that Areas 3 (Vt) and 6a (NY) increase their allocations to fluid uses *absolutely* as well as *relatively* in the five-year period. Area 3 (Vt) would increase its shipments to Area 4 (M-RI) by 1.35 million hundredweight according to the solutions. Area 6a (NY) would increase shipments of fluid milk to Areas 5 (Ct) and 7 (NJ) by .57 and 4.06 million hundredweight, respectively. All of the areas except Area 2 (NH) decrease the amount allocated to fluid

Table 17. Projected Changes in Spatial Allocation of Fluid Milk Between 1968 and 1972, Northeast Areas

Changes in fluid milk supply: Area		quantity (mil. cwt.)	Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a
			Changes in fluid milk demand (mil. cwt.)											
1	Me	- .71	-.12			- .59								
2	NH	- .31		+.02		- .33								
3	Vt	+1.33			-.02	+1.35								
4	M-RI	-1.03				-1.03								
5	Ct	- .54					-.54							
6a	NY	+4.50					+.57	-.13		+4.06				
6b	NY	- .48							-.48					
7	NJ	-2.18								-2.18				
8a+	Pa 1/	-1.89								-1.59	-.91			+.61
8b	Pa	- .57										-.57		
8c	Pa	- .09											-.09	
10a	Md	- .42												-.42
Total		-2.39	-.12	+.02	-.02	- .60	+.03	-.13	-.48	+ .29	-.91	-.57	-.09	+.19

1/ Includes 8a, 9 and 10b.

uses within their own areas. In one case, a switching pattern emerges—Area 8a+ switches some of its fluid shipments away from Area 7 (NJ) to Area 10a (Md).

The spatial allocation of total quantities of fluid milk is shown in Appendix Tables 7-11. New York, Pennsylvania and Vermont are, of course, the major dairy states and it should not be surprising, therefore, that Areas 8a+ (Pa), 6a (NY) and 3 (Vt) ship the largest quantities of fluid milk to other areas.

The flows of inter-area fluid milk shipments are shown in Figure 3. These flows remain virtually unchanged in terms of direction of flow for the 1968-72 period (the flow from 8a to 10a begins in the second year). It should be noted that Areas 2 (NH) and 1 (Me) provide an important source of fluid milk for the Boston market, but the projected quantity of flow decreases through time. As mentioned previously, the projected flows from Area 3 (Vt) and Area 6a (NY) increase.

Potential future sources of fluid milk are shown in Table 18. These are the areas that have excess milk remaining after all intra-area demand has been met and inter-area shipments have been made. During the period 1968-72, the greatest impact on excess-fluid supplies would occur in Areas 3 (Vt) and 6a (NY). This implies that new sources of fluid supply will most likely be sought in these areas in the future. The other areas, 6b, 8b and 8c, as will be seen later, face a relatively strong intra-area demand for both fluid and manufacturing milk and, consequently, do not offer as much potential as a source as their excess supply may suggest.

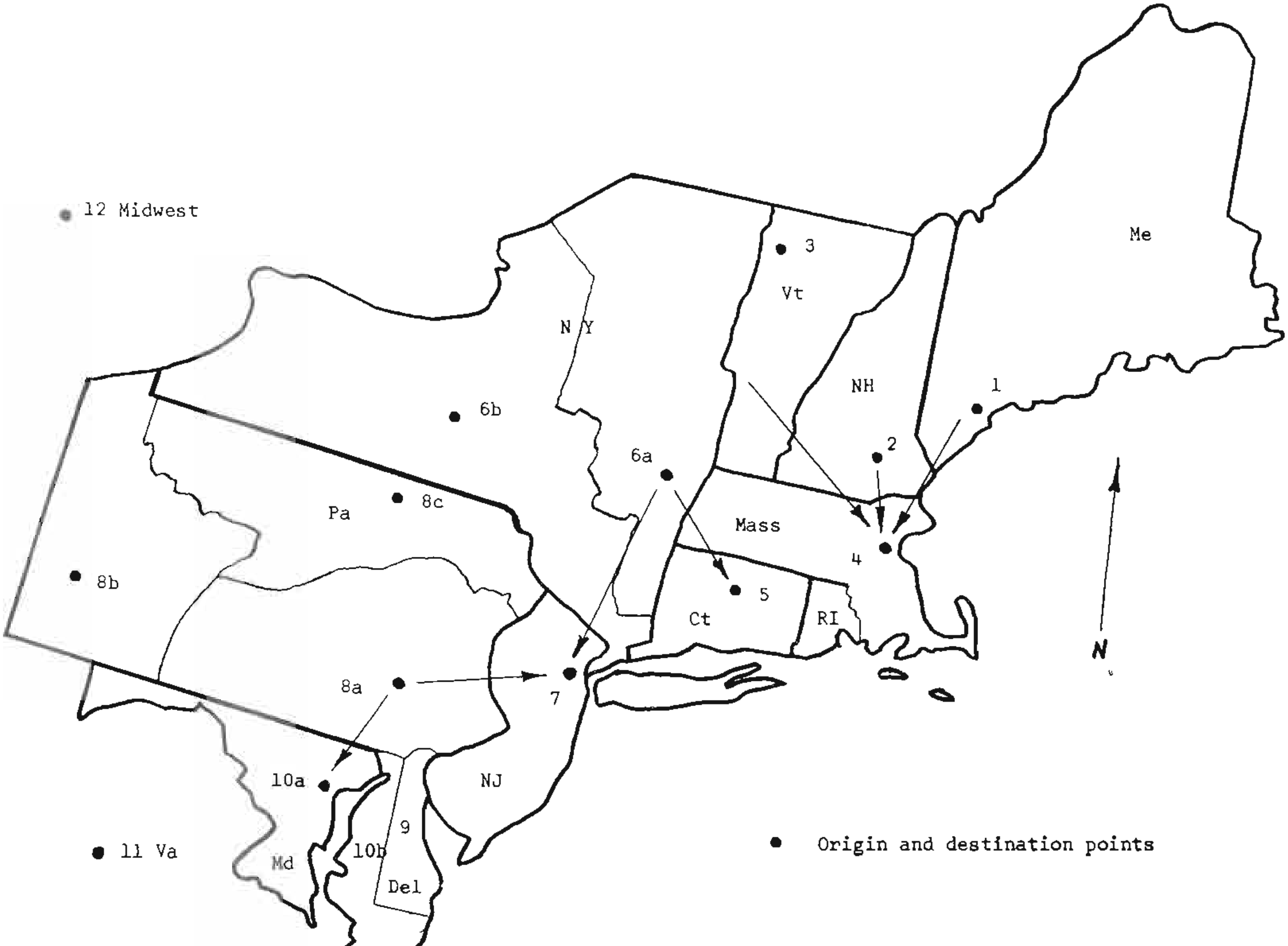


Figure 3. Projected Inter-area Shipment of Fluid Milk, Northeastern Areas, 1972

Table 18. Estimated Excess-Fluid Milk Remaining in Excess Supply Areas after Inter-area Shipments, Northeastern Areas, 1968 and 1972

Area		Excess-Fluid Milk Remaining After Inter-area Shipments		Percent change
		1968	1972	1968-72
		(mil. cwt.)		
3	Vt	7.10	4.75	-33
6a	NY	16.44	11.03	-33
6b	NY	15.40	13.69	-11
8b	Pa	3.64	3.44	- 5
8c	Pa	12.96	12.11	- 7

<u>Projected changes in spatial allocation of manufacturing milk between 1968 and 1972</u>

Since the manufacturing milk supply is essentially the residual after fluid demand is met, changes in the allocation of manufacturing milk are usually the converse of changes in fluid milk allocation. For example, if an area allocates a higher proportion of its supply to fluid milk then obviously it allocates a smaller proportion to manufacturing milk uses. The solutions show that this would happen markedly in Areas 3 (Vt) and 6a (NY) and to a lesser extent in the other excess-fluid supply areas (Table 19). Vermont's allocation to manufacturing uses would decrease 2.47 million hundredweight and New York's Area (6a) would decrease 5.52 million hundredweight. As a consequence shipments of manufacturing milk products from the Midwest region would shift somewhat from New Jersey, Pennsylvania and New York (6b) to the Massachusetts-Rhode Island and Connecticut areas to replace the reduced shipments from Vermont and New York (6a).

In this study, the supply of manufacturing milk available from sources outside of the Northeast region was assumed to remain constant during the 1968-72 period. This assumption combined with an application of anticipated backward-shifting of regional supply functions and a residual method of determining the manufacturing milk supply results in 12.03 million hundredweight estimated decline in regional manufacturing milk consumption over the time period. It is of interest to note that this negative change occurs even though a positive shift in manufacturing milk demand was anticipated and applied in the model. This behavior of the model demonstrates that if fluid milk allocation is given preferential treatment, then much of the corrective adjustment in allocation must be accomplished in the manufacturing milk market. Of course, this is precisely the intent of

Table 19. Projected Changes in Spatial Allocation of Manufacturing Milk Between 1968 and 1972, Northeast Areas

Changes in manufacturing milk supplied			Changes in manufacturing milk demanded											
			Me	NH	Vt	M-RI	Ct	NY	NY	NJ	Pa 1/	Pa	Pa	Md
Area		quantity	1	2	3	4	5	6a	6b	7	8a+	8b	8c	10a
		(mil. cwt.)	(mil. cwt.)											
1	Me	- .07	-.07											
2	NH	- .04		-.04										
3	Vt	-2.47	-.22	-.10	-.08	-2.07								
4	M-RI	- .12				- .12								
5	Ct	- .06					- .06							
6a	NY	-5.52				-3.53	-1.59	-.40						
6b	NY	-1.95							-1.95					
7	NJ	- .24								- .24				
8a+	Pa 1/	- .21									- .21			
8b	Pa	- .28										- .28		
8c	Pa	- .96							- .72				-.24	
10a	Md	- .11												-.11
11	Va													
12	MW					+3.94	+1.23		-1.08	-1.03	-1.91	- .92		-.23
Total		-12.03	-.29	-.14	-.08	-1.78	- .42	-.40	-3.75	-1.27	-2.12	-1.20	-.24	-.34

1/ Includes 8a, 9 and 10b.

price administration policies which are aimed at price and output stability in the fluid milk market.

The assumption of a constant outside supply is probably unrealistic. The gap between a growing manufacturing milk demand and a slacking in regional milk output would probably be filled by shipments from outside supply sources. However, such an increase in shipments from outside the Northeast region would not affect the general direction of inter-area changes. (Its only effect would be to temper the increase in manufacturing milk prices resulting from the decline in regional supply.)

The flows of inter-area manufacturing milk shipments are shown in Figure 4. 1/ Again as with fluid milk the direction of major flows remains practically unchanged in the time period. The only change is the addition of a flow from Area 12 (Midwest) to Area 4 (M-RI) beginning in the third year of the period. Notice that according to the solutions the excess-fluid supply areas of 8a+, 8b and 6b do not have any out-going manufacturing milk flows whereas the other excess-fluid areas (3, 6a and 8c) do ship to other areas. The reason is that the former areas have a larger local demand for milk than the latter areas. Moreover, the former areas do not meet their demand with their own supplies as evidenced by the flows from the Midwest supply area.

It should be mentioned that in reality there are undoubtedly many inter-area flows between most of the bordering areas. In fact, quite often there are flows in both directions, i.e., some Connecticut farmers

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1/ The spatial allocation of total quantities of manufacturing milk is presented in Appendix Tables 12-16.

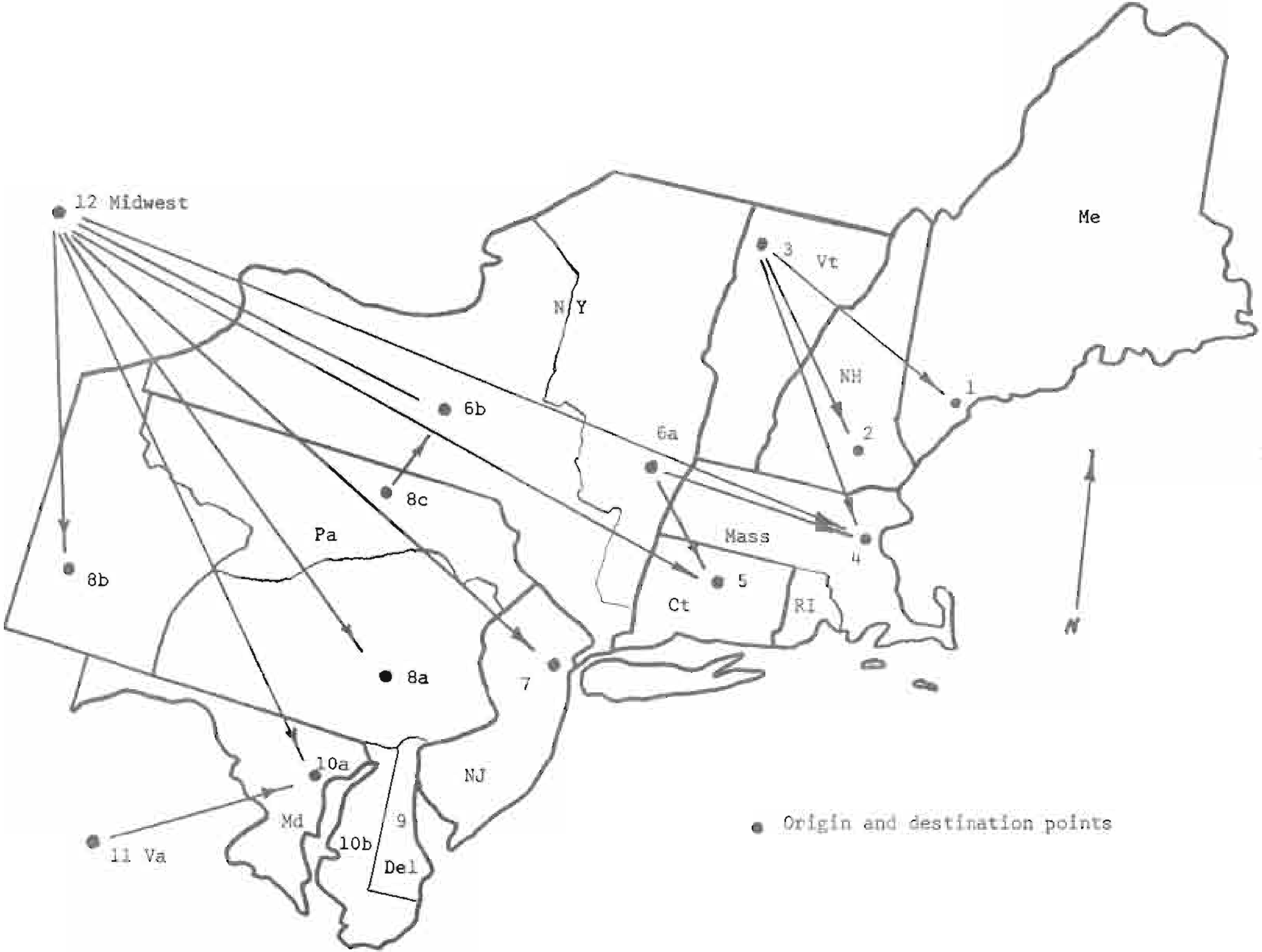

Figure 4. Projected Inter-area Shipments of Manufacturing Milk, Northeastern Areas, 1972

ship milk to Massachusetts and some Massachusetts farmers ship milk to Connecticut. The solutions obtained in this study should be thought of as net flows. It is impractical, if not impossible, to simulate all of the real inter-area shipments. However, since many real shipments counterbalance each other their detailed inclusion would probably not alter or improve the results of the analysis greatly.

Locations where concentrated dairy farming may continue

If dairy farming remains concentrated to any extent in the Northeast region it will likely do so in Areas 3 (Vt), 6a (NY), 6b (NY), 8a+ (Pa), 8b (Pa) and 8c (Pa). On the basis of the solutions obtained, it seems that Areas 3 (Vt) and 6a (NY) have the most favorable economic conditions for continued intensive dairy farming.

The favorable conditions are as follows:

(1) Projections indicate that these areas would move toward a higher proportion of fluid milk sales. Consequently, blend prices would rise and thereby prospects for profitable dairy farming would prevail.

(2) Urban-industrial expansion would probably be slow in these areas (assuming anticipated population growth is an acceptable proxy measure of urban-industrial expansion).

(3) Locationally these areas are advantageously close to rapidly growing demand areas, such as the Boston and Connecticut markets.

One possible unfavorable condition for intensive dairy farming in Areas 3 (Vt) and 6a (NY) is the potential competition that could stem from growth of the outdoor recreation industry. Natural resources in these areas are conducive to both summer and winter outdoor recreational activities. Expansion of the outdoor recreation industry usually involves a conversion of some farm land into recreational land use. Nevertheless, it would seem reasonable to expect that pockets of intensive dairy farming could continue in these areas and, in the sense of open space, complement the recreational use of resources.

C. Prospects of a Rising Time Path of Milk Prices

The third question posed in the introduction is: Will the price of milk rise substantially as the supply expansion potential decreases? The solutions presented thus far suggest the on-going changes in demand and supply are setting the stage for substantial price rises for milk. Output is contracting and demand is remaining fairly stable. A higher proportion of the milk supply is being allocated to fluid uses. More inter-area shipments of fluid milk are being made and, consequently, transportation costs are rising. Therefore, it seems reasonable to expect the solutions will show a rising time path of milk prices.

The time paths of price and output

Figure 5 and Table 20 show representative time paths of blend milk prices for the Northeast region. Over-all, the region's blend prices would rise practically constantly at about 1.3 percent per year. This would be roughly a mirror image of the downward movement (- 1.5 percent) of the Northeast region's milk output. Obviously, these solution-price rises would be exclusive of inflationary trends. The major cause for the rise in price would be a decrease in supply coupled with a relatively constant demand.

Ordinarily, the greater the contraction in output over time, the

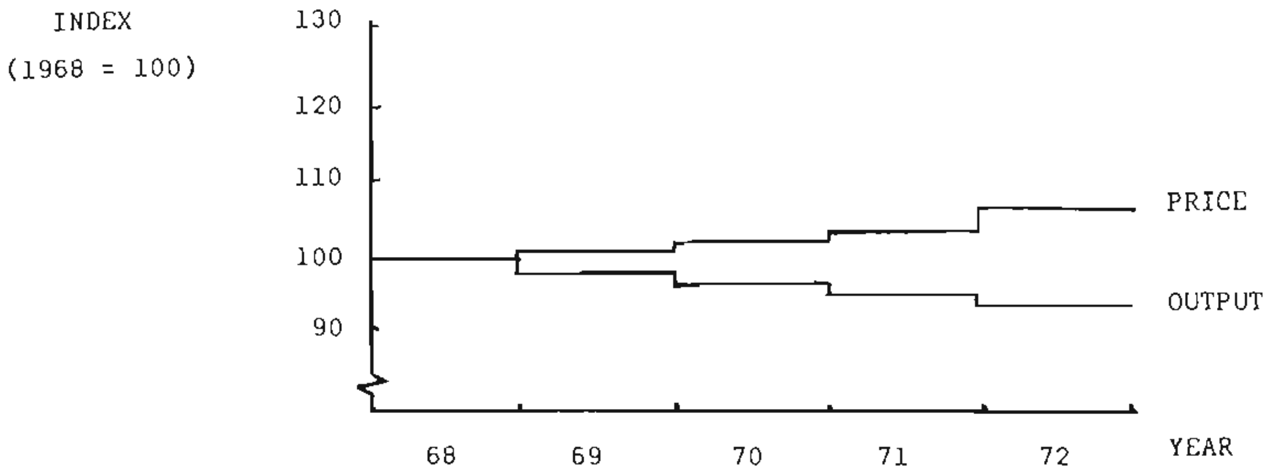

Figure 5. Indices of Estimated Blend Milk Prices and Output, Northeast Region, 1968-72

Table 20. Indices of Estimated Blend Price and Output, Northeast Region, Area 6a, Area 2, and Area 4, 1968-72

Area, Price and Output	Year 1968	1969	1970	1971	1972
			Prices and quantities		
Northeast Region					
Weighted Ave. Blend Price ($)	5.58	5.75	5.91	6.07	6.25
Output (mil. cwt.)	243.10	239.62	236.37	232.69	228.69
Area 6a (NY)					
Blend Price ($)	5.06	5.32	5.63	5.92	6.21
Output (mil. cwt.)	30.55	30.14	29.97	29.79	29.53
Area 2 (NH)					
Blend Price ($)	6.28	6.37	6.49	6.62	6.75
Output (mil. cwt.)	3.75	3.68	3.57	3.49	3.40
Area 4 (M-RI)					
Blend Price ($)	6.43	6.52	6.64	6.76	6.90
Output (mil. cwt.)	7.98	7.72	7.43	7.14	6.83
			Percent		
Northeast Region					
Weighted Ave. Blend Price	100.0	101.3	102.7	104.0	105.2
Output	100.0	98.5	97.2	95.7	94.0
Area 6a (NY)					
Blend Price	100.0	105.1	111.3	116.9	122.7
Output	100.0	98.7	98.1	97.5	96.7
Area 2 (NH)					
Blend Price	100.0	101.4	103.3	105.4	107.5
Output	100.0	98.1	95.2	93.1	90.7
Area 4 (M-RI)					
Blend Price	100.0	101.4	103.3	105.1	107.3
Output	100.0	96.7	93.1	89.5	85.6

greater the rise in price. This relationship holds true, subject to the condition that all other factors remain constant. However, the multistage allocation model is designed for use on problems in which "all other factors do not remain constant." An interesting outcome of this particular application of the multistage model is that the price-output relationship tends to be just the opposite, i.e., the smaller the contraction in output over time, the greater the increase in price.

A look at the price time paths for individual areas will demonstrate this seemingly contradictory outcome (Figure 6). For purposes of brevity, the time paths for only three areas are presented to show the relationship. Area 6a (NY) represents Group (a), the "relatively small output decline--relatively large price rise" areas (Table 21). These are the low "fluid-proportion" areas. Area 2 (NH) represents Group (b), the "relatively moderate output decline--relatively small price rise" areas. These are the high "fluid-proportion" areas.

The greatest relative increase in prices would occur in Group (a). A variety of reasons account for this. Areas 3 (Vt) and 6a (NY) benefit from increased shipments of fluid milk to neighboring areas, thereby increasing the proportion of their total supply allocated to fluid supply. Area 8c's blend price rises mainly because of the relatively large rise in the manufacturing milk part of the blend price. Its fluid proportion of supply rises only slightly (remaining at about 15 percent) during the time period. Rising manufacturing milk prices, in this case, are influenced mainly by the regional contraction in supply. Area 8b (Pa) allocates a higher proportion of its fluid milk to its own "high-priced" area (i.e., less fluid is shipped to neighboring areas). Area 6b (NY) also allocates

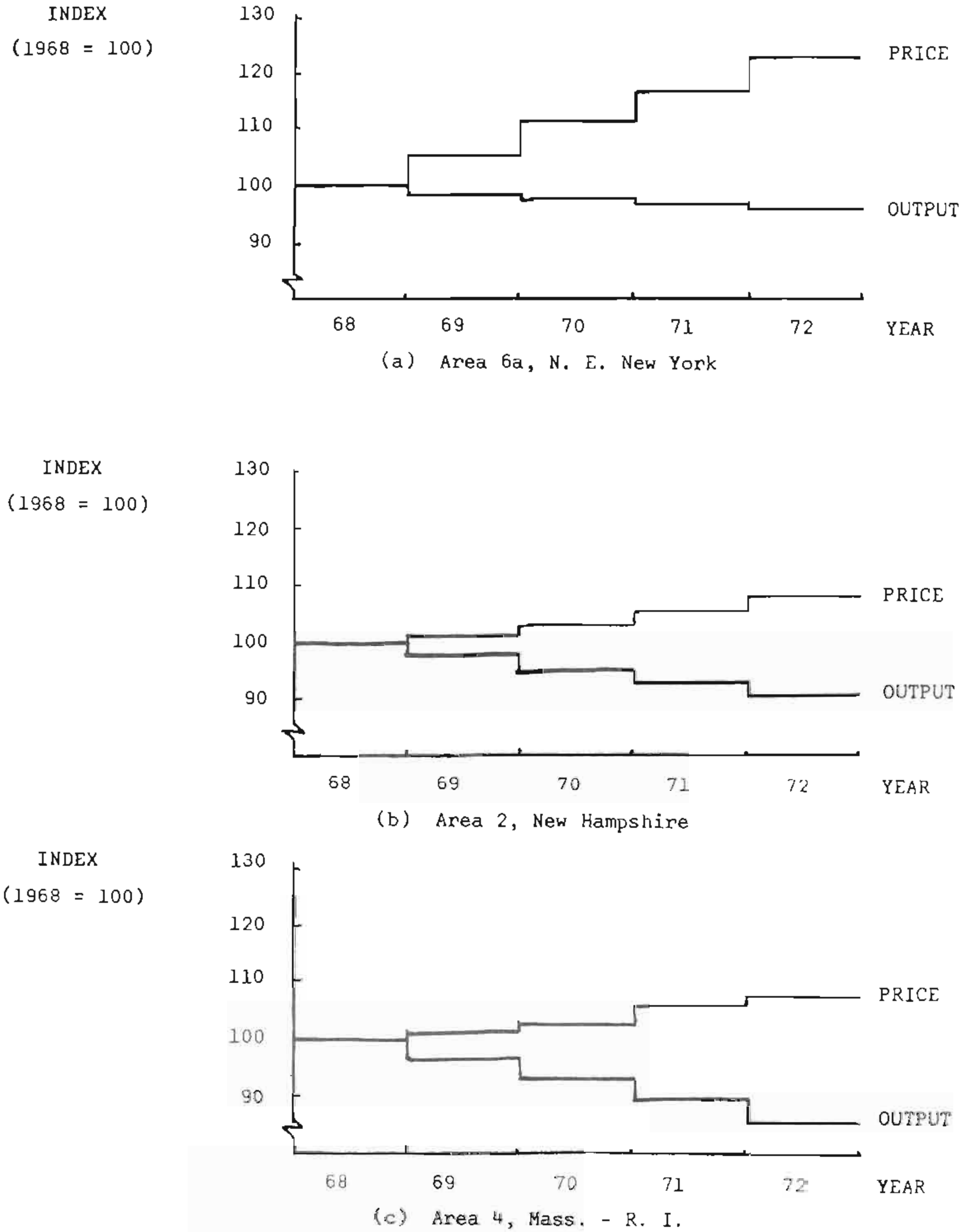

Figure 6. Indices of Estimated Blend Milk Prices and Output, Selected Northeastern Areas, 1968-72

Table 21. Percentage Changes in Estimated Milk Output and Blend Milk Prices, by Time Path Groups, Northeastern Areas, 1968-72

Area		Percent Change in Milk Output (1968-72)	Percent Change in Blend Price (1968-72)
(a)	Relatively small output decline - relatively large price rise		
8c	Pa	- 6	+25
6a	NY	- 3	+23
3	Vt	- 6	+18
8b	Pa	- 5	+13
10a	Md	- 4	+13
6b	NY	- 3	+10
(b)	Relatively moderate output decline - relatively moderate price rise		
8a+	Pa	- 5	+ 8
2	NH	- 9	+ 7
5	Ct	- 9	+11
(c)	Relatively large output decline - relatively small price rise		
1	Me	-13	+ 8
4	M-RI	-14	+ 7
7	NJ	-29	+ 5

a larger proportion of its supply to fluid uses (from 69 to 71 percent). Area 10a (Md) has the largest increase in demand in the region and, consequently, along with Area 6a (NY) has the highest relative increase in fluid price in the region. This variety of reasons can be summed up as being mostly "inter-area dependency effects." That is, the price-output relationship within the areas is partially dependent upon the price-output relationships outside of the areas. Thus, "inter-area dependency effects" account for some of the seemingly contradictory price-output time paths. For Group (a) a relatively small decrease in output seems to result in a relatively large increase in price but this is not contradictory in light of the "inter-area dependency effects."

Group (b) is composed of areas which had already allocated a high proportion of their milk supply to fluid uses in the base year. Demand in these areas increases moderately and supply decreases moderately. Most of the rise in the time path for this group results from increases in fluid prices.

Group (c) areas also have a high proportion of milk allocated to fluid uses but compared to the other areas have a large decline in output. Demand-supply forces in Area 4 (M-Rl) involve a backward shifting of both supply and demand. The supply shift is greater than the demand shift and, therefore, this influence on administered fluid prices results in a moderate rise through time. Moreover, the availability of fluid supplies from neighboring areas dampens the price rise. In the model, pricing of fluid milk for Area 1 (Me) is tied to the price for Area 4 (M-RI) and accordingly, its time path reflects that of Area 4. A similar explanation covers the results for Area 7 (NJ). In the latter case, the fluid milk pricing is tied to the price for Area 6b (NY). Thus the provision for administrative pricing, in which it is assumed that administrators in several of the markets attempt to maintain constant intermarket fluid price differentials also accounts for some of the seemingly contradictory price-output time paths.[1/] That is, for Group (c) areas a large decrease in output seems to result in only a moderate increase in price primarily because price administration is operative in the model.

Comparison of estimated results with reported data

A comparison of the estimated results with reported data serves as a check on the reasonableness of the estimates and the reliability of the model in making projections. The foregoing results are subject to qualifications depending upon the outcome of this comparison.

Since the reported data are available only on a state basis, it is necessary to recombine the areas to state designations in order to make the comparisons. Milk production for the ten state-designated areas is presented in Table 22. Comparison of the estimated and reported milk production for 1968 and 1969 suggests that the two sets of data are reasonably close except that the model overestimates production slightly, particularly in the first year.

The estimated blend prices also are reasonably close to the reported blend prices (Table 23). In fact, four of the compared pairs have less than $.03 difference between estimated and reported prices. The others are almost equally divided between underestimates and overestimates.

1/ The areas involved in this "pricing option" are listed in Appendix A.

Table 22. Estimated and Reported Milk Production for Northeastern States, 1968-72 *

Year	1 Me	2 NH	3 Vt	4 M-RI	5 Ct	6 NY	7 NJ	8 Pa	9 Del	10 Md
	(million hundredweight)									
1968										
Estimated	6.16	3.75	18.92	7.98	6.67	105.19	8.34	69.47	1.28	15.38
Reported	5.90	3.55	18.49	7.73	6.69	100.74	7.93	68.12	1.33	15.16
1969										
Estimated	5.99	3.68	18.50	7.72	6.56	104.60	7.83	68.20	1.17	15.35
Reported	6.12	3.59	18.93	7.56	6.72	101.69	7.81	69.11	1.35	15.49
1970										
Estimated	5.79	3.57	18.30	7.43	6.41	103.71	7.21	67.73	1.05	15.16
1971										
Estimated	5.57	3.49	18.06	7.14	6.24	102.82	6.58	66.95	.92	14.95
1972										
Estimated	5.37	3.40	17.78	6.83	6.06	101.74	5.92	66.11	.79	14.70

* Reported data were obtained from Milk Production, Disposition and Income [12].

Table 23. Estimated and Reported Blend Milk Prices for Northeastern States, 1968-72 *

Year	1 Me	2 NH	3 Vt	4 M-RI	5 Ct	6 NY	7 NJ	8 Pa	9 Del	10 Md
	(dollars per hundredweight)									
1968										
Estimated	6.31	6.28	5.21	6.43	6.84	5.35	6.22	5.46	6.12	6.45
Reported	6.30	6.20	5.89	6.34	6.54	5.51	5.92	5.87	6.05	6.12
1969										
Estimated	6.40	6.37	5.44	6.52	6.97	5.48	6.24	5.71	6.33	6.55
Reported	6.54	6.38	6.08	6.54	6.75	5.78	6.13	6.10	6.35	6.26
1970										
Estimated	6.53	6.49	5.67	6.64	7.16	5.68	6.34	5.80	6.37	6.77
1971										
Estimated	6.65	6.62	5.90	6.76	7.35	5.85	6.43	5.96	6.50	6.95
1972										
Estimated	6.79	6.75	6.14	6.90	7.56	6.05	6.53	6.11	6.60	7.17

* Reported data were obtained from Milk Production, Disposition and Income [12].

Accuracy of the estimates is important, but perhaps of more significance is consistency between estimated and reported data with respect to direction of change. For the purpose of testing consistency in direction of change several years of changes should be used; however, only the 1968-69 changes in reported prices and production are available for the 1968-72 period. With this limitation in mind, a test for consistency is made by classifying the state-designated areas into the three groups used previously for presenting the estimated five-year changes in price and output. Then the areas are evaluated on the basis of their reported data to see if they would fit the same group characteristics they had on the basis of estimated data. A comparison of Table 24 with Table 21 brings out one noticeable difference. Whereas the estimated changes in output are all negative, all of the reported changes except two are positive. Another difference is that the areas do not seem to vary as much for reported price changes as they do for estimated price changes. Nevertheless, the reported data for most of the individual areas is consistent with estimated data in several respects. For example, Areas 6 (NY) and 8 (Pa) in Group (a) have the highest relative increase in reported blend prices and have a relatively small increase in reported milk output (compared to the estimated small decrease in output). In Group (b), Areas 2 (NH) and 5 (Ct) have moderate changes in reported milk output when compared to those reported for the other areas and the estimated percentage price increase for Area 5 (Ct) is very close to the reported change (multiply 3.2 percent by 4 for comparison). In Group (c), Areas 4 (M-RI) and 7 (NJ) have changes in reported milk output going in the same negative direction as the estimated changes,

Table 24. Percentage Changes in Reported Milk Production and Blend Milk Prices, by Time Path Groups, Northeastern Areas, 1968-69 *

Group and Area	Percent Change in Reported Milk Production (1968-69)	Percent Change in Reported Blend Price (1968-69)
Group (a)		
6 NY	+ .9	+4.9
3 Vt	+2.4	+3.2
8 Pa	+1.5	+3.9
10 Md	+2.2	+2.3
Group (b)		
2 NH	+1.1	+2.9
5 Ct	+ .4	+3.2
Group (c)		
1 Me	+3.7	+3.8
4 M-R1	-2.2	+3.1
7 NJ	-1.5	+3.5

* Calculations of percentages were made from reported data presented in Appendix Tables 17 and 20.

although the magnitude is larger for the estimated change. On the inconsistency side, the most obvious one concerns Area 1 (Me) which would appear to belong in Group (b) instead of Group (c) according to reported data.

In general, the test for consistency shows that the estimated results compare favorably with reported data in several respects, but the results may need to be qualified for Area 1 (Me). Again, it should be mentioned that a test based on a one-year reported change compared with a five-year estimated change is not adequate for conclusive confirmation or rejection of the results. A better test would be to wait until 1973 or 1974 to place both reported and estimated data on a comparable five-year basis. Needless to say, such a wait would render the projection useless. Any projection into an uncertain future contains a probability of error. Hopefully, the multistage allocation model minimizes the probability of error.

Over-all, the time paths indicate that in the Northeast manufacturing milk prices will probably rise relatively more rapidly than fluid milk prices in the near future. Also blend prices will increase moderately as output expansion slows down or perhaps declines moderately. And finally, the low "fluid-proportion" areas will tend to "catch-up" to the high "fluid-proportion" areas in blend prices as higher proportions of their milk are allocated to fluid uses. Particularly, Areas 6a (NY), 3 (Vt) and 8c (Pa) should experience relatively large gains in blend milk prices.

VI. SUMMARY AND CONCLUSIONS

This study examined the on-going shifting patterns of milk supply and demand in the Northeast and estimated the potential outcome of these changes for the near future. Recent thrusts of urban-industrial expansion have caused shifts in milk supply and demand to the extent that the dairy industry could conceivably become dispersed and disadvantaged in the Northeast. The major objective of this study was to project the spatial allocation of milk in the Northeast and to trace the time paths of milk prices and output for the period 1968-72.

A multistage allocation model was used for the analysis. It is composed of linear and quadratic programming formulations which are linked together in a framework of five time-oriented stages of milk production and marketing. A provision is made in the model for price administration in the fluid milk market and for perfectly competitive pricing in the manufacturing milk market.

Input data for the model consisted of five-year sets of demand and supply functions for each of the ten state-designated areas of the Northeast. Inter-area transportation costs and base year data were also used in the model. Parameter shifters were used in constructing the five-year sets of demand and supply functions to reflect the interyear, anticipated changes in population, income and production technology for each of the areas.

The multisolution produced by the model was scanned for information that would answer questions regarding the prospects in the Northeast for (1) an adequate fluid milk supply, (2) a relocation of concentrated dairy farming and (3) a substantial rise in the time path of milk prices.

The first question discussed was: Will the excess fluid milk producing areas continue to meet the deficit areas' demand for milk in 1972? The solutions suggest that the region's over-all excess fluid milk supply would decline only slightly (from 79.9 to 67.9 million hundredweight between 1968 and 1972). Individual areas within the region would have differing effects. Areas that are already fluid-deficit would generally have the largest relative declines (thereby increasing their deficits). However, the excess-fluid areas would continue to have ample supplies with which to meet the deficit areas' demands in 1972.

The second question discussed was: Will the producing areas relocate in the face of urban-industrial expansion and concentrate in predominantly agricultural areas? Changes in the spatial allocation of fluid milk indicate that Areas 3 (Vt) and 6a (NY) would expand their allocations to fluid use through shipments to neighboring areas. This implies that Areas 3 (Vt) and 6a (NY) would likely experience growth or concentration of dairy farming while many other areas would experience contraction and dispersion of dairy farming. Urban-industrial expansion would probably be slow in Areas 3 (Vt) and 6a (NY) and, except for possible competition from the outdoor recreation industry, these areas would have favorable conditions for continued intensive dairy farming.

The third question discussed was: Will the price of milk rise substantially as the supply expansion potential decreases? Over-all, the regions' blend prices would rise almost constantly at about 1.3 percent per year. This is roughly a mirror image of the region's projected downward movement (- 1.5 percent) in milk output. Variations in the price time paths would occur among areas. These variations were used to classify the areas into three groups. Those with a "relatively small output decline--relatively large price rise" formed Group (a) consisting of Areas 3 (Vt), 6a (NY), 6b (NY), 8b (Pa), 8c (Pa) and 10a (Md). The price-output time paths for this group seem contradictory in the sense that ordinarily the smaller the decrease in supply over time the smaller the increase in price (all other factors remaining constant). However, primarily because of "inter-area dependency" effects this group has the largest relative increase in price even though it has the smallest relative decrease in supply.

Areas with a "relatively moderate output decline--relatively moderate price rise" were classified as Group (b) which consists of Areas 2 (NH), 5 (Ct) and 8a+ (Pa). This group had already allocated a high proportion of its milk to fluid uses in the base year and the price-rise of its time paths reflected that for the region as a whole.

A third group included those areas with a "relatively large output decline--relatively small price rise." Again the price-output time paths seem contradictory. They are plausible, though, in light of the administrative pricing provision incorporated in the model. The provision maintains constant inter-area fluid price differentials for those areas that correspond to the Federal Milk Order markets. Thus inter-area dependency again influences the form of the price-output time paths.

A test for reasonable accuracy of the estimates and consistency in direction of change was made by comparing the estimated data with reported data for 1968-69. The estimates were reasonably close and consistent in most respects. Nevertheless, the results should probably be qualified on two points. One, the change in supply for the region, in general, may probably be slightly less in decline than projected and, two, the price-output time paths for Area 1 (Me) may probably show a moderate rise for both output and price rather than an output decline with a small price rise.

Basically the spatial allocations and time paths suggest that in the future the low "fluid-proportion" areas will tend to "catch-up" to the high "fluid-proportion" areas with respect to blend prices. Those expected to experience relatively large gains in blend milk prices by 1972 are Areas 6a (NY), 3 (Vt) and 8c (Pa).

The Northeast can be expected to continue having a viable dairy industry although it will likely relocate gradually. Movement of dairy farming to areas beyond the periphery of urban-industrial expansion involves a mixture of farm exits, entries and growth to such an extent that the movement is almost imperceptive. However, this study involving gross movements as represented by shifting demand and supply functions suggests that conditions for a gradual relocation and dispersion of the dairy industry exist. On the basis of the projections, it seems conceivable that dairy farming may become more disagglomerated in Connecticut, Massachusetts, Rhode Island, New Hampshire, New Jersey, south-central New York, Maryland and eastern Pennsylvania as supply contraction takes place. On the other hand, the projections indicate that prospects for continued concentrations of dairy farming prevail in Maine, northeastern New York, western and central Pennsylvania and Vermont. Of prime importance is the indication that the pace of movements may be sufficiently slow in all areas so that the dairy industry may continue to serve as a buffer zone against the threats on environmental quality from urban-industrial expansion.

APPENDIX A

THE PRICING FORMULA USED FOR COMPUTING THE PRICE OF FLUID MILK IN STAGE 3 OF THE MULTISTAGE ALLOCATION MODEL

The Pricing Formula

The pricing formula used in this study is generally representative of the kind used historically by milk market administrators. (Currently the use of formulas is being held in abeyance in some Federal Milk Order markets and a proposal for a national formula is under study.) The following formula, although hypothetical, essentially accomplishes the objective of an actual administrative pricing policy:

The general formula is

$$P_j = (1 + \lambda_j)\, P_j^{t-1}$$

where

P_j = the administered price in Area j and year t $(j = 1, 2, \ldots n)$

λ_j = the price adjustment coefficient

P_j^{t-1} = the administered price in the previous year.

The price adjustment coefficient is computed as follows:

$$\lambda = \frac{1}{\varepsilon} \left[\frac{a_i\,(S_i - S_i^{t-1}) - b_j\,(Q_j^{t-1} - Q_j^{t-2})}{Q_j^{t-1}} \right]$$

where

ε = price elasticity of the demand-supply combination

a_i = the normal ratio of the milk marketed and produced in Area i to the total milk produced in Area i $(0 \leq a \leq 1.0)$

b_j = the normal ratio of fluid milk consumed in Area j to the total milk produced in Area j $(0 \leq b \leq 1.0)$

Q_j^{t-1} = the quantity of milk consumed (demanded) in year $t-1$ and Area j.

Q_j^{t-2} = the quantity of milk consumed (demanded) in year $t-2$ and Area j.

The Pricing Option

The computer program was written to allow the option of "constant intermarket price differentials" for areas which correspond closely to the Federal Milk Order market areas. Fluid prices for all areas were first calculated by the above formula, but then the option was used to tie the prices of several areas to those of other areas as follows:

$$P_1 = P_4 - .05$$

$$P_2 = P_4 - .15$$

$$P_3 = P_4 - .20$$

$$P_{6a} = P_5 - .20$$

$$P_7 = P_{6b} + .30$$

$$P_{8c} = P_{6b} - .10$$

$$P_{8b} = P_{8a} - .20$$

The above price differentials are equal to the transportation costs between the selected areas. In effect, the pricing option ties the northern New England prices to the Boston price, the eastern New York price to the Connecticut price, the New Jersey price to the New York price, the north central Pennsylvania price to the New York price and the western Pennsylvania price to the Philadelphia market price.

The "Market Share" Ratios

One of the basic assumptions of the pricing formula is that an objective of the administrator is to set a price that will encourage producers in his area to supply sufficient milk to maintain their share of the market. For this purpose the following market ratios were used:

$a_1 = .47$	$b_1 = 1.00$
$a_2 = .60$	$b_2 = 1.00$
$a_3 = .07$	$b_3 = 1.00$
$a_4 = .90$	$b_4 = .41$
$a_5 = .90$	$b_5 = .73$
$a_{6a} = .17$	$b_{6a} = 1.00$
$a_{6b} = .69$	$b_{6b} = 1.00$
$a_7 = .90$	$b_7 = .41$
$a_{8a} = .59$	$b_{8a} = 1.00$
$a_{8b} = .71$	$b_{8b} = 1.00$
$a_{8c} = .15$	$b_{8c} = 1.00$
$a_{10a} = .89$	$b_{10a} = 1.00$

The Price Elasticity of the Demand-Supply Combination

Since both demand and supply are involved in the pricing formula, it is necessary to use an elasticity measure of the combined effect of both demand and supply price elasticities. Thus we have

$$\varepsilon = (e_d - e_s)$$

where

ε = price elasticity of the demand-supply combination

e_d = price elasticity of demand

e_s = price elasticity of supply

The pricing formula uses the inverse of the price elasticity and the ε^{-1} used for this study was -1.50 for all areas. It was obtained by calculating the data for Area 5 (Ct) and then using the result as an approximation for all areas. The demand and supply point elasticities are shown in Appendix Table 1. Using the data for Area 5 we obtain

$$\varepsilon = (-.212 - .083)$$

$$= (-.295)$$

$$\varepsilon^{-1} = -3.39.$$

This number was then halved approximately to -1.50 on the assumption that the administrator operates in the realm of risk and uncertainty and would not attempt to adjust price to the full extent of the elasticity measure.

Appendix Table 1. Elasticities of the Demand and Supply Functions used in the Multistage Model, Northeastern States, 1968

Area	Fluid Demand Elasticity at \$7.00 per cwt.1/	Manufacturing Demand Elasticity at \$4.50 per cwt.1/	Supply Elasticity at \$6.00 per cwt.2/
1 Me	.23	.95	.12
2 NH	.23	.90	.09
3 Vt	.23	.88	.11
4 M-RI	.22	.85	.09
5 Ct	.21	.82	.08
6 NY	.22	.84	.10
7 NJ	.22	.85	.10
8 Pa	.22	.89	.09
9 Del	.22	.81	.10
10 Md	.22	.86	.11

1/ The point elasticity of demand for fluid milk was calculated from the demand functions for 1968 (see Table 11) as follows:

$$e_{fd} = (dQ/dP)\ (P/Q).$$

The point elasticity of demand for manufacturing milk was calculated from the demand functions for 1968 (see Table 11) as follows:

$$e_{md} = (dX/dM)\ (M/X).$$

2/ The point elasticity of supply was calculated from the supply functions for 1968 (see Table 9) as follows:

Convert

$$S = \alpha + \beta \log_{10} (B-k)$$

to

$$S = \alpha + [\beta/(\ln 10)] \ln (B-k).$$

Then

$$e_s = [dS/d(B-k)]\ [(B-k)/S]$$
$$= [\beta/(B-k)]\ (1/\ln 10)\ [(B-k)/S].$$

APPENDIX B

BASE YEAR DATA

Appendix Table 2. Milk Production and Price of Milk Sold to Plants and Dealers, 1967

Area	Price of Milk Sold to Plants and Dealers a/	Reported Production of Milk b/	Estimated Production of Milk c/
	($ per cwt.)	(mil. cwt.)	(mil. cwt.)
1 Me	6.00	6.07	6.3076
2 NH	6.00	3.68	3.8267
3 Vt	5.55	18.30	19.1041
4 M-RI	6.10	8.24	8.2315
5 Ct	6.29	6.93	6.7921
6 NY	5.17	104.55	105.6109
7 NJ	5.57	8.79	8.9647
8 Pa	5.67	71.11	69.8806
9 Del	5.91	1.40	1.3868
10 Md	5.86	15.16	15.4587

a/ Milk Production, Disposition and Income 1967-68 [12, p. 9].
b/ Ibid., pps. 6 and 7.
c/ Estimated by the procedure developed by Zepp [17]. (1966 prices were used in the 1967 supply functions.)

Appendix Table 3. Population Per Capita Milk Consumption, and Total Milk Consumption, Northeastern States, 1967

Area	Estimated population[a/]	Estimated Per Capita Consumption[b/]		Estimated Total Consumption	
		Fluid milk	Manufacturing milk	Fluid milk	Manufacturing milk
	(thousand)	(pounds)	(pounds)	(mil. cwt.)	(mil. cwt.)
1 Me	986	302	281	2.9777	2.77
2 NH	690	307	287	2.1183	1.98
3 Vt	417	305	284	1.2719	1.18
4 M-RI	6315	314	295	19.8291	18.63
5 Ct	2916	320	302	9.3312	8.80
6 NY	18007	317	298	57.0822	53.66
7 NJ	6971	316	297	22.0284	20.70
8 Pa	11670	309	289	36.0603	33.73
9 Del	524	315	297	1.6506	1.56
10 Md	3681	313	293	11.5215	10.79
TOTAL	52177			163.8742	153.80

a/ Current Population Report, Population Estimates [3].
b/ Zepp [18, pp. 9 and 10].

Appendix Table 4. Federal Milk Order Prices, 1967

	Price at 3% B.F.	B.F. Premium	Percent B.F.	Diff. (8¢/ .1%)	Price adj. for B.F. diff.	Percent Class I
			Class I			
Connecticut	6.79	8.1	3.69	.16	6.95	79
Mass.-R.I.-N.H.	6.32	8.1	3.76	.208	6.53	61
New York-N.J.	6.01	4.0	3.62	.048	6.06	50
Delaware Valley	6.54	8.1	3.7	.16	6.70	78
Upper Chesapeake	6.43	8.3	3.73	.184	6.61	70
	(p.50)	(p.52)	(p.34)			(p.42)
			Class II			
Connecticut	3.97	8.1	3.69	.16	4.13	
Mass.-R.I.-N.H.	3.91	8.1	3.76	.21	4.12	
New York-N.J.	3.91	8.1	3.62	.16	4.07	
Delaware Valley	3.99	8.1	3.7	.16	4.15	
Upper Chesapeake	3.93	8.1	3.73	.16	4.09	
	(p.71)	(p.71)	(p.34)			
			Blend Price			
Connecticut	6.19	8.1				
Mass.-R.I.-N.H.	5.22 a/	8.1				
New York-N.J.	5.02 b/	6.1				
Delaware Valley	6.02 c/	8.0				
Upper Chesapeake	5.68 d/	8.2				
	(p.78)	(p.78)				

Source: Federal Milk Order Market Statistics [6].

a/ 201-210 mile zone, Boston.
b/ " " " " , N. Y., & Class IA & Class 1B.
c/ Philadelphia.
d/ Baltimore.

APPENDIX C

SUB-DIVISION AND RECOMBINATION OF AREAS

A second set of areas was demarcated in order to have the areas correspond more closely to the geographical areas covered by the existing Federal Milk Order Markets. For this purpose New York was divided into two subareas; Pennsylvania was divided into three, and Maryland was divided into two subareas.

The supply data for these areas were divided on the basis of the percent cows and the demand data were divided on the basis of percent population in each subarea. The number and percent of cows and population are as follows:

	No. of Cows	%	Population	%
New York				
Area 6a	332,961	29	1,585,900	9
" 6b	802,254	71	16,268,900	91
Total	1,134,315	100	17,854,800	100
Pennsylvania				
Area 8a	387,575	49	6,552,699	58
" 8b	204,272	26	3,964,612	35
" 8c	199,073	25	802,055	7
Total	790,920	100	11,319,366	100
Maryland				
Area 10a	136,154	78	3,367,630	93
" 10b	39,061	22	264,510	7
Total	175,215	100	3,632,140	100

Sources: Data on number of cows by counties were from the Agway 1964 Census of Agriculture Analysis, Agway, Inc., Syracuse, New York, 1966.
Data on population for Pennsylvania were from the 1960 Census of Population, Vol. 1, Characteristics of the Population, U. S. Bureau of the Census, Parts 22, 34, 40, 47, U. S. Government Printing Office, Washington, D. C. 1963.
Data on population for New York were for 1964 and were from New York State Statistical Yearbook 1968-69, State Capital, Albany, N. Y., March 1969.
Data on population for Maryland were for 1966 and were from Maryland Statistical Abstract, State Office Building, Annapolis, Md., October 1967.

Appendix Table 5. Milk Supply Functions, Areas Resulting from the Subdivisions and Recombination of New York, Pennsylvania, Delaware and Maryland, 1968-72

Area and Year	Quantity intercept (α)	Slope coefficient (β)
	(mil. cwt.)	
6a NY		
1968	29.4678	3.3929
1969	29.1802	3.3053
1970	28.8676	3.2177
1971	28.5298	3.1301
1972	28.1670	3.0424
6b NY		
1968	72.1453	8.3069
1969	71.4412	8.0923
1970	70.6758	7.8778
1971	69.8489	7.6632
1972	68.9605	7.4488
8a Pa		
1968	37.2762	4.1061
1969	36.7595	3.9705
1970	36.1949	3.8350
1971	36.1949	3.8350
1972	35.5823	3.6994
	34.9220	3.5637
8b Pa		
1968	17.4289	1.8833
1969	17.2318	1.8277
1970	17.0155	1.7722
1971	16.7799	1.7167
1972	16.5250	1.6611
8c Pa		
1968	16.7586	1.8109
1969	16.5691	1.7574
1970	16.3611	1.7040
1971	16.1345	1.6506
1972	15.8895	1.5972
10a Md		
1968	11.3700	1.4754
1969	11.2533	1.4194
1970	11.1118	1.3635
1971	10.9456	1.3076
1972	10.7546	1.2516

Appendix Table 6. Milk Demand Functions, Areas Resulting from the Subdivision and Recombination of New York, Pennsylvania, Delaware and Maryland, 1968-72

Area and Year	Fluid Milk: Quantity intercept (γ)	Fluid Milk: Slope coefficient (δ)	Manufacturing Milk: Quantity intercept (θ)	Manufacturing Milk: Slope coefficient (ϕ)
		(mil. cwt.)		
6a NY				
1968	6.0856	0.1567	8.5051	0.8676
1969	6.0938	0.1585	8.7007	0.8775
1970	6.1020	0.1603	8.9008	0.8875
1971	6.1102	0.1621	9.1055	0.8976
1972	6.1185	0.1640	9.3149	0.9078
6b NY				
1968	61.5318	1.5844	85.9955	8.7722
1969	61.6149	1.6024	87.9734	8.8722
1970	61.6981	1.6207	89.9968	8.9733
1971	61.7814	1.6392	92.0667	9.0756
1972	61.8648	1.6578	94.1843	9.1791
8a Pa				
1968	27.9430	0.7253	38.4427	4.0155
1969	27.8265	0.7286	39.1253	4.0347
1970	27.7108	0.7322	39.8210	4.0542
1971	27.5962	0.7358	40.5300	4.0739
1972	27.4828	0.7394	41.2524	4.0938
8b Pa				
1968	15.0648	0.3917	20.6683	2.1684
1969	14.9769	0.3928	21.0011	2.1749
1970	14.8892	0.3940	21.3392	2.1814
1971	14.8021	0.3952	21.6827	2.1880
1972	14.7155	0.3964	22.0318	2.1945
8c Pa				
1968	3.0130	0.0783	4.1337	0.4337
1969	2.9954	0.0786	4.2002	0.4350
1970	2.9778	0.0788	4.2678	0.4363
1971	2.9604	0.0790	4.3365	0.4376
1972	2.9431	0.0793	4.4064	0.4389
10a Md				
1968	13.0204	0.3341	18.0421	1.8495
1969	13.1708	0.3409	18.6447	1.8877
1970	13.3229	0.3480	19.2675	1.9269
1971	13.4768	0.3553	19.9110	1.9668
1972	13.6324	0.3626	20.5760	2.0074

APPENDIX D

SUPPLEMENTAL DATA

Appendix Table 7. Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model, Northeastern States, 1968

Supply Areas	Demand Areas: Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Excess	Seasonal surplus	Total Supply
							(mil. cwt.)								
1 Me	2.98			2.56										0.62	6.16
2 NH		2.12		1.25										0.38	3.75
3 Vt			1.26	8.66									7.10	1.89	18.91
4 M-RI				7.18										0.80	7.98
5 Ct					6.00									0.67	6.67
6a NY					3.33	5.00		2.71					16.44	3.05	30.53
6b NY							51.78						15.40	7.46	74.64
7 NJ								7.51						0.83	8.34
8a+ Pa 1/								11.66	23.28					3.88	38.82
8b Pa										12.62			3.64	1.81	18.07
8c Pa											2.54		12.96	1.72	17.22
10a Md												10.76	0.05	1.20	12.01
Total	2.98	2.12	1.26	19.65	9.33	5.00	51.78	21.88	23.28	12.62	2.54	10.76	55.59	24.31	243.10

1/ Includes 8a, 9 and 10b.

Appendix Table 8. Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model, Northeastern States, 1969

	Demand Areas														
Supply Areas	Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa [1/] 8a+	Pa 8b	Pa 8c	Md 10a	Excess	Seasonal surplus	Total Supply
							(mil. cwt.)								
1 Me	2.95			2.44										0.60	5.99
2 NH		2.13		1.18										0.37	3.68
3 Vt			1.26	8.94									6.45	1.85	18.50
4 M-RI				6.95										0.77	7.72
5 Ct					5.90									0.66	6.56
6a NY					3.45	4.98		3.22					15.49	3.01	30.15
6b NY							51.76						15.25	7.45	74.46
7 NJ								7.05						0.78	7.83
8a+ Pa [1/]								11.74	22.91			0.05		3.85	38.55
8b Pa										12.41			3.63	1.78	17.82
8c Pa											2.52		12.20	1.64	16.36
10a Md												10.80		1.20	12.00
Total	2.95	2.13	1.26	19.51	9.35	4.98	51.76	22.01	22.91	12.41	2.52	10.85	53.02	23.96	239.62

1/ Includes 8a, 9 and 10b.

Appendix Table 9. Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model, Northeastern States, 1970

Supply Areas	Demand Areas: Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Excess	Seasonal surplus	Total Supply
							(mil. cwt.)								
1 Me	2.92			2.29										0.58	5.79
2 NH		2.13		1.08										0.36	3.57
3 Vt			1.25	9.28									5.94	1.83	18.30
4 M-RI				6.69										0.74	7.43
5 Ct					5.77									0.64	6.41
6a NY					3.59	4.95		4.33					14.11	3.00	29.98
6b NY							51.60						14.77	7.37	73.74
7 NJ								6.49						0.72	7.21
8a+ Pa 1/								11.23	22.79			0.22		3.80	38.04
8b Pa										12.32			3.60	1.77	17.69
8c Pa											2.49		12.24	1.64	16.37
10a Md												10.66		1.18	11.84
Total	2.92	2.13	1.25	19.34	9.36	4.95	51.60	22.05	22.79	12.32	2.49	10.88	50.66	23.63	236.37

1/ Includes 8a, 9 and 10b.

Appendix Table 10. Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model, Northeastern States, 1971

Supply Areas	Demand Areas Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Excess	Seasonal surplus	Total Supply
							(mil. cwt.)								
1 Me	2.88			2.13										0.56	5.57
2 NH		2.13		1.01										0.35	3.49
3 Vt			1.25	9.63									5.37	1.81	18.06
4 M-RI				6.43										0.71	7.14
5 Ct					5.62									0.62	6.24
6a NY					3.74	4.91		5.53					12.63	2.98	29.79
6b NY							51.47						14.25	7.30	73.02
7 NJ								5.92						0.66	6.58
8a+ Pa 1/								10.68	22.57			0.40		3.74	37.39
8b Pa										12.18			3.52	1.74	17.44
8c Pa											2.47		12.19	1.63	16.29
10a Md												10.51		1.17	11.68
Total	2.88	2.13	1.25	19.20	9.36	4.91	51.47	22.13	22.57	12.18	2.47	10.91	47.96	23.27	232.69

1/ Includes 8a, 9 and 10b.

Appendix Table 11. Spatial Allocation of Fluid Milk, Stage 3, Multistage Allocation Model, Northeastern States, 1972

Supply Areas	Demand Areas: Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Excess	Seasonal surplus	Total Supply
	(mil. cwt.)														
1 Me	2.86			1.97										0.54	5.37
2 NH		2.14		0.92										0.34	3.40
3 Vt			1.24	10.01									4.75	1.78	17.78
4 M-RI				6.15										0.68	6.83
5 Ct					5.46									0.60	6.06
6a NY					3.90	4.87		6.77					11.03	2.95	29.52
6b NY							51.30						13.69	7.22	72.21
7 NJ								5.33						0.59	5.92
8a+ Pa 1/								10.07	22.37			0.61		3.67	36.72
8b Pa										12.05			3.44	1.72	17.21
8c Pa											2.45		12.11	1.62	16.18
10a Md												10.34		1.15	11.49
Total	2.86	2.14	1.24	19.05	9.36	4.87	51.30	22.17	22.37	12.05	2.45	10.95	45.02	22.86	228.69

1/ Includes 8a, 9 and 10b.

Appendix Table 12. Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model, Northeastern States, 1968

Supply Areas	Demand Areas Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Total Supply
						(mil. cwt.)							
1 Me	0.61												0.61
2 NH		0.38											0.38
3 Vt	1.93	1.55	1.25	4.27									9.00
4 M-RI				0.80									0.80
5 Ct					0.67								0.67
6a NY				12.98	1.59	4.94							19.51
6b NY							22.86						22.86
7 NJ								0.83					0.83
8a+ Pa 1/									3.88				3.88
8b Pa										5.45			5.45
8c Pa							12.16				2.52		14.68
10a Md												1.26	1.26
11 V												4.50	4.50
12 C					6.60		16.83	20.58	18.73	7.78		5.12	75.64
Total	2.54	1.93	1.25	18.05	8.86	4.94	51.85	21.41	22.61	13.23	2.52	10.88	160.07

1/ Includes 8a, 9 and 10b.

Appendix Table 13. Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model, Northeastern States, 1969

Supply Areas	Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Total Supply
	Demand Areas (mil. cwt.)												
1 Me	0.60												0.60
2 NH		0.37											0.37
3 Vt	1.87	1.53	1.23	3.67									8.30
4 M-RI				0.77									0.77
5 Ct					0.66								0.66
6a NY				13.17	0.48	4.84							18.49
6b NY							22.70						22.70
7 NJ								0.78					0.78
8a+ Pa 1/									3.85				3.85
8b Pa										5.41			5.41
8c Pa							11.37				2.46		13.83
10a Md												1.20	1.20
11 V												4.50	4.50
12 C					7.61		16.87	20.34	18.23	7.51		5.10	75.66
Total	2.47	1.90	1.23	17.61	8.75	4.84	50.94	21.12	22.08	12.92	2.46	10.80	157.12

1/ Includes 8a, 9 and 10b.

Appendix Table 14. Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model, Northeastern States, 1970

Supply Areas	Demand Areas: Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 8a+ 1/	Pa 8b	Pa 8c	Md 10a	Total Supply
						(mil. cwt.)							
1 Me	0.58												0.58
2 NH		0.36											0.36
3 Vt	1.82	1.50	1.21	3.24									7.77
4 M-RI				0.74									0.74
5 Ct					0.64								0.64
6a NY				12.36		4.74							17.10
6b NY							22.14						22.14
7 NJ								0.72					0.72
8a+ Pa 1/									3.80				3.80
8b Pa										5.36			5.36
8c Pa							11.47				2.41		13.88
10a Md												1.18	1.18
11 V												4.50	4.50
12 C				0.82	8.04		16.52	20.14	17.80	7.29		5.06	75.67
Total	2.40	1.86	1.21	17.16	8.68	4.74	50.13	20.86	21.60	12.67	2.41	10.74	154.44

1/ Includes 8a, 9 and 10b.

Appendix Table 15. Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model, Northeastern States, 1971

Supply Areas	Demand Areas: Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Total Supply
	(mil. cwt.)												
1 Me	0.56												0.56
2 NH		0.35											0.35
3 Vt	1.77	1.48	1.19	2.74									7.18
4 M-RI				0.71									0.71
5 Ct					0.62								0.62
6a NY				10.96		4.65							15.61
6b NY							21.56						21.56
7 NJ								0.66					0.66
8a+ Pa 1/									3.74				3.74
8b Pa										5.27			5.27
8c Pa							11.48				2.35		13.83
10a Md												1.17	1.17
11 V												4.50	4.50
12 C				2.32	7.94		16.13	19.87	17.33	7.08		4.98	75.65
Total	2.33	1.83	1.19	16.73	8.56	4.65	49.17	20.53	21.07	12.35	2.35	10.65	151.41

1/ Includes 8a, 9 and 10b.

Appendix Table 17. Estimated Blend Milk Prices, Northeastern Areas, 1968-72

Area		1968	1969	1970	1971	1972	Percent change 1968-72
				(dollars)			
1	Me	6.31	6.40	6.53	6.65	6.79	8
2	NH	6.28	6.37	6.49	6.62	6.75	7
3	Vt	5.21	5.44	5.67	5.90	6.14	18
4	M-RI	6.43	6.52	6.64	6.76	6.90	7
5	Ct	6.84	6.97	7.16	7.35	7.56	11
6a	NY	5.06	5.32	5.63	5.92	6.21	23
6b	NY	5.46	5.55	5.70	5.83	5.98	10
7	NJ	6.22	6.24	6.34	6.43	6.53	5
8a+	Pa 1/	6.12	6.33	6.37	6.50	6.60	8
8b	Pa	5.39	5.69	5.75	5.92	6.07	13
8c	Pa	4.06	4.31	4.55	4.80	5.06	25
10a	Md	6.45	6.55	6.77	6.95	7.17	11

1/ Includes Areas 8a (Pa), 9 (Del) and 10b (Md).

Appendix Table 16. Spatial Allocation of Manufacturing Milk, Stage 4, Multistage Allocation Model, Northeastern States, 1972

Supply Areas	Me 1	NH 2	Vt 3	M-RI 4	Ct 5	NY 6a	NY 6b	NJ 7	Pa 1/ 8a+	Pa 8b	Pa 8c	Md 10a	Total Supply
	Demand Areas (mil. cwt.)												
1 Me	0.54												0.54
2 NH		0.34											0.34
3 Vt	1.71	1.45	1.17	2.20									6.53
4 M-RI				0.68									0.68
5 Ct					0.61								0.61
6a NY				9.45		4.54							13.99
6b NY							20.91						20.91
7 NJ								0.59					0.59
8a+ Pa 1/									3.67				3.67
8b Pa										5.17			5.17
8c Pa							11.44				2.28		13.72
10a Md												1.15	1.15
11 V												4.50	4.50
12 C				3.94	7.83		15.75	19.55	16.82	6.86		4.89	75.64
Total	2.25	1.79	1.17	16.27	8.44	4.54	48.10	20.14	20.49	12.03	2.28	10.54	148.04

1/ Includes 8a, 9 and 10b.

Appendix Table 18. Estimated Fluid Milk Prices, Northeastern Areas, 1968-72

Area		1968	1969	1970	1971	1972	Percent change 1968-72
		(dollars)					
1	Me	6.60	6.67	6.77	6.88	6.94	5
2	NH	6.50	6.57	6.67	6.78	6.89	6
3	Vt	6.45	6.52	6.62	6.73	6.84	6
4	M-RI	6.65	6.72	6.82	6.93	7.04	6
5	Ct	7.12	7.23	7.41	7.59	7.79	9
6a	NY	6.92	7.03	7.21	7.39	7.59	10
6b	NY	6.15	6.15	6.23	6.29	6.37	4
7	NJ	6.45	6.45	6.53	6.59	6.67	3
8a+	Pa 1/	6.43	6.75	6.72	6.84	6.91	7
8b	Pa	6.23	6.55	6.52	6.64	6.71	8
8c	Pa	6.05	6.05	6.13	6.19	6.27	4
10a	Md	6.76	6.82	7.03	7.20	7.41	10

1/ Includes Areas 8a (Pa), 9 (Del) and 10b (Md).

Appendix Table 19. Estimated Manufacturing Milk Prices, Northeastern Areas, 1968-72

Area		1968	1969	1970	1971	1972	Percent change 1968-72
				(dollars)			
1	Me	4.38	4.66	4.95	5.24	5.53	26
2	NH	4.32	4.60	4.89	5.18	5.47	27
3	Vt	3.96	4.24	4.53	4.82	5.11	29
4	M-RI	4.45	4.73	5.02	5.31	5.60	26
5	Ct	4.33	4.61	4.88	5.17	5.46	26
6a	NY	4.11	4.39	4.68	4.97	5.26	28
6b	NY	3.89	4.17	4.44	4.73	5.02	29
7	NJ	4.09	4.37	4.64	4.93	5.22	28
8a+	Pa 1/	3.94	4.22	4.49	4.78	5.07	29
8b	Pa	3.43	3.71	3.98	4.27	4.56	33
8c	Pa	3.71	3.99	4.26	4.55	4.84	30
10a	Md	3.87	4.15	4.42	4.71	5.00	29

1/ Includes Areas 8a (Pa), 9 (Del) and 10b (Md).

Appendix Table 20. Product-use Allocation of Milk, Northeastern Areas, 1968-72

Area and allocation	1968	1969	1970	1971	1972
			(mil. cwt.)		
Area 1 Me					
Allocated to fluid					
Within the area	2.98	2.95	2.92	2.88	2.86
Shipped out	2.56	2.44	2.29	2.13	1.97
Allocated to mfg.					
Within the area	.62	.60	.58	.56	.54
Shipped out					
Inshipments					
Fluid					
Manufacturing	1.93	1.87	1.82	1.77	1.71
Area 2 NH					
Allocated to fluid					
Within the area	2.12	2.13	2.13	2.13	2.14
Shipped out	1.25	1.18	1.08	1.01	.92
Allocated to mfg.					
Within the area	.38	.37	.36	.35	.34
Shipped out					
Inshipments					
Fluid					
Manufacturing	1.55	1.53	1.50	1.48	1.45
Area 3 Vt					
Allocated to fluid					
Within the area	1.26	1.26	1.25	1.25	1.24
Shipped out	8.66	8.94	9.28	9.63	10.01
Allocated to mfg.					
Within the area	1.25	1.23	1.21	1.19	1.17
Shipped out	7.75	7.07	6.56	5.99	5.36
Inshipments					
Fluid					
Manufacturing					
Area 4 M-RI					
Allocated to fluid					
Within the area	7.18	6.95	6.69	6.43	6.15
Shipped out					
Allocated to mfg.					
Within the area	.80	.77	.74	.71	.68
Shipped out					
Inshipments					
Fluid	12.47	12.56	12.65	12.77	12.90
Manufacturing	17.25	16.84	16.42	16.02	15.59

Appendix Table 20. (continued)

Area and allocation	1968	1969	1970	1971	1972
			(mil. cwt.)		
Area 5 Ct					
Allocated to fluid					
Within the area	6.00	5.90	5.77	5.62	5.46
Shipped out					
Allocated to mfg.					
Within the area	.67	.66	.64	.62	.60
Shipped out					
Inshipments					
Fluid	3.33	3.45	3.59	3.74	3.90
Manufacturing	8.19	8.09	8.04	7.94	7.83
Area 6a NY					
Allocated to fluid					
Within the area	5.00	4.98	4.95	4.91	4.87
Shipped out	6.04	6.67	7.92	9.27	10.67
Allocated to mfg.					
Within the area	4.94	4.84	4.74	4.65	4.54
Shipped out	14.57	13.65	12.36	10.96	9.45
Inshipments					
Fluid					
Manufacturing					
Area 6b NY					
Allocated to fluid					
Within the area	51.78	51.76	51.60	51.47	51.30
Shipped out					
Allocated to mfg.					
Within the area	22.86	22.70	22.14	21.56	20.91
Shipped out					
Inshipments					
Fluid					
Manufacturing	28.99	28.24	27.99	27.61	27.19
Area 7 NJ					
Allocated to fluid					
Within the area	7.51	7.05	6.49	5.92	5.33
Shipped out					
Allocated to mfg.					
Within the area	.83	.78	.72	.66	.59
Shipped out					
Inshipments					
Fluid	14.37	14.96	15.56	16.21	16.84
Manufacturing	20.58	20.34	20.14	19.87	19.55

Appendix Table 20. (continued)

Area and allocation	1968	1969	1970	1971	1972
			(mil. cwt.)		
Area 8a+ Pa					
Allocated to fluid					
Within the area	23.28	22.91	22.79	22.57	22.37
Shipped out	11.66	11.79	11.45	11.08	10.68
Allocated to mfg.					
Within the area	3.88	3.85	3.80	3.74	3.67
Shipped out					
Inshipments					
Fluid					
Manufacturing	18.73	18.23	17.80	17.33	16.82
Area 8b Pa					
Allocated to fluid					
Within the area	12.62	12.41	12.32	12.18	12.05
Shipped out					
Allocated to mfg.					
Within the area	5.45	5.41	5.36	5.27	5.17
Shipped out					
Inshipments					
Fluid					
Manufacturing	7.78	7.51	7.29	7.08	6.86
Area 8c Pa					
Allocated to fluid					
Within the area	2.54	2.52	2.49	2.47	2.45
Shipped out					
Allocated to mfg.					
Within the area	2.62	2.46	2.41	2.35	2.28
Shipped out	12.06	11.37	11.47	11.48	11.44
Inshipments					
Fluid					
Manufacturing					
Area 10a Md					
Allocated to fluid					
Within the area	10.76	10.80	10.66	10.51	10.34
Shipped out					
Allocated to mfg.					
Within the area	1.26	1.20	1.18	1.17	1.15
Shipped out					
Inshipments					
Fluid					
Manufacturing	9.62	9.60	9.56	9.48	9.39

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